OGP

Geospatial Integrity of Geoscience Software Part 3 – User guide for the GIGS Test Dataset

Report No. 430-3

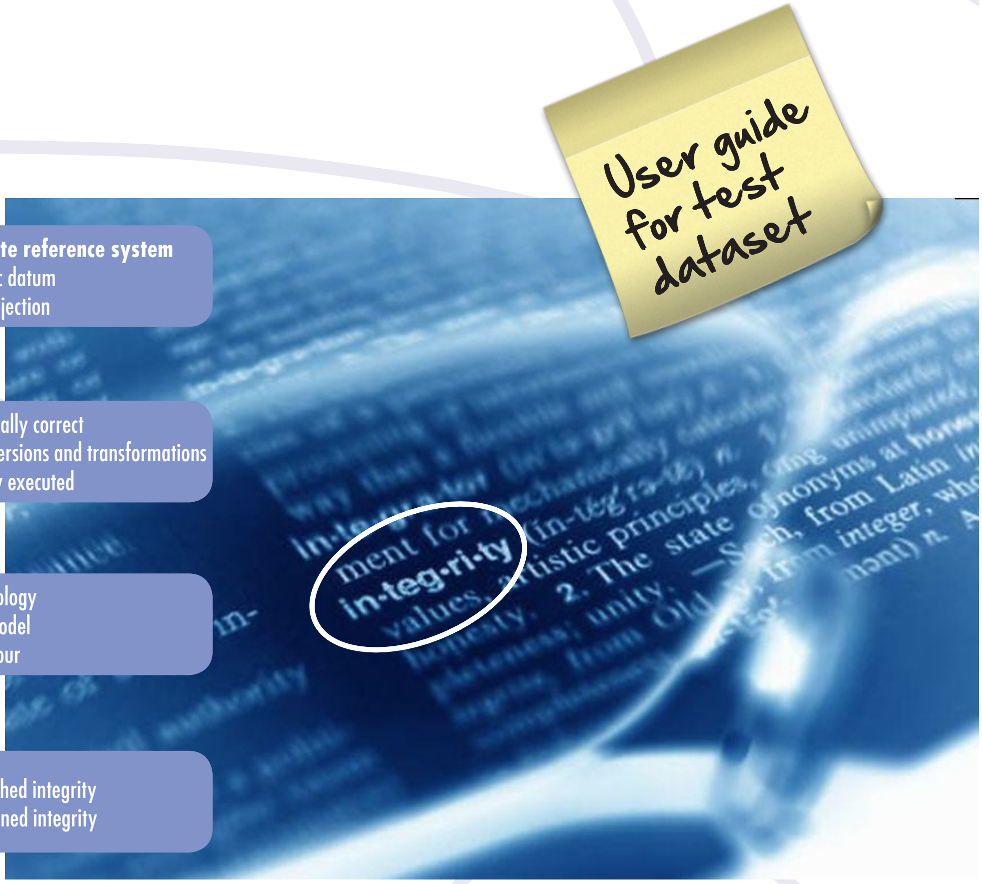
September 2011

Complete:
Coordinate reference system
- Geodetic datum
- Map Projection

Correct:
- Numerically correct
- All conversions and transformations correctly executed

Consistent:
- Terminology
- Data model
- Behaviour

Verifiable:
- Established integrity
- Maintained integrity



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Geospatial Integrity of Geoscience Software
Part 3 – User guide for the GIGS Test Dataset

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Preface

The purpose of this guidance note is to provide geoscience software developers and users with recommended industry best practice to evaluate the capabilities of their software with respect to establishing and maintaining geospatial data integrity. The guidance note is a response to significant concern and user experiences of violations of geospatial integrity of data when using geoscience software, leading to incorrect results, inconsistent understanding and misleading information for the user community.

In 2008 this led to the formation of a joint industry project (JIP) sponsored by OGP to review the situation and produce a series of recommendations, a supported set of standard test data, and procedures for undertaking software review utilising that test data. OGP has taken the results of this Geospatial Integrity of Geoscience Software (GIGS) JIP and incorporated them in this guidance note which is in three parts:

Part 1 – GIGS Guidelines (OGP report № 430–1), describing the GIGS process;

Part 2 – GIGS Software Review (OGP report № 430–2, this document), containing a software review checklist to enable structured testing of geoscience software; and

Part 3 – User guide for the GIGS Test Dataset (OGP report № 430–3, this document).

This guidance note is supplemented by a number of companion electronic files:

- *Software review checklist* – an MS-Excel spreadsheet intended to facilitate the execution of a geoscience software review and capture its results;
- *GIGS Test Dataset* – a series of data files to be used for testing of the algorithms and data exchange capabilities of the geoscience software.
- *Sample MS PowerPoint slides* – explaining GIGS process and business benefits.

The above digital documents and files are available from the OGP Geomatics Committee website – http://info.ogp.org.uk/geomatics.

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1 – Overview of the GIGS Test Dataset

1.1 Introduction

This document describes the GIGS Test Dataset and procedures for using it.

The GIGS test data was designed for use in the evaluation of the geospatial integrity of geoscience software examined within the GIGS project; it was also to remain as a test harness for future reviews of geoscience software after publication of the GIGS guidelines.

The review and evaluation process is described in part 1 of this three-part guidance note. As described in part 1, the tests have been split into a number of groupings, referred to as Test Series:

- 0000 – Coordinates and coordinate metadata
- 1000 – Documentation and Release Notes
- 2000 – Pre-defined Geodetic Parameter Library
- 3000 – User Defined Geodetic Parameter Library
- 4000 – The User Interface
- 5000 – Data Operations. The tests for this series can be considered to be in three categories:
  - Tests for coordinate conversions and coordinate transformations (Series 5100 and 5200)
  - Tests for geospatial integrity of the positions of geoscience data (Series 5300, 5400, and 5500)
  - Tests for cultural or interpreted data and imagery (Series 5600)
- 6000 Audit Trail
- 7000 Deprecation
- 8000 Error Trapping

The review process is guided by checklists which describe what the reviewer should test for within the software (part 2 of this guidance note). In many places these checklists direct the reviewer to carry out test procedures using data from the GIGS Test Dataset. This part 3 document describes the test data and procedures for using that test data.

The GIGS Test Dataset consists of a series of files provided in a variety of formats including industry data exchange formats and Microsoft Excel v2003 (.xls). Each file is designed for a specific GIGS test. Where practical, data from one test is reused for other test procedures. The test data can be described as being in one of three categories:

Geodetic data definitions, used for the series 2000 (pre-defined geodetic parameter library), series 3000 (user-defined geodetic parameter library) and series 7000 (deprecation) tests;

Conversion and transformation data, used for Data Operations series 5100 (map projections) and 5200 (other coordinate operations) tests;

Seismic and wellbore data, used for Data Operations series 5300 (2D seismic location data), 5400 (3D seismic location data) and 5500 (wellbore data) tests.

There are no test data files for the Documentation and Release Notes (Series 1000) or Error Trapping (Series 8000) tests. Some User Interface (Series 4000) and Audit Trail (Series 6000) tests utilise test data used in the Series 5000 tests. At this time, boundary and cultural data have not been developed for inclusion in the GIGS Test Dataset.

1.2 Test data availability

The GIGS Test Dataset is made available for download from the OGP website (http://info.ogp.org.uk/geomatics) as a zipped file, containing various nested folders grouped for each Test Series. The test data files are indexed in Appendix A1.

1.3 Test data file naming

The GIGS test data files include a four digit number within their file names. The first digit corresponds to the Test Series in which the relevant test is described. For example test data file 2001 is utilised in one (or more) of the tests in Test Series 2000, and test data file 5201 is utilised in one (or more) of the tests in Test Series 5000[2].

The test data may occasionally be updated or supplemented. When this happens the version and date embedded within the test data file itself, in the test file name and in the name of the zip file are all amended.

The test data files are referenced in the text below as:
GIGS_conv_5201_GeogGeocen_input_[version_date].xls.

1.4 Test data geodetic object definitions

Each of the geodetic objects created in the GIGS Series 3000 test procedures is given an artificial GIGS code and name. These geodetic objects are used in tests in other Series. Most, but not all, of these objects correspond to a real world geodetic object which is already in the EPSG Geodetic Parameter Dataset. The creation of special GIGS geodetic objects is deliberate. Firstly, these GIGS definitions mitigate against geodetic objects that exist in the pre-defined libraries within geoscience software using a correct name but incorrect parameters (e.g. the British National Grid has erroneously been defined in some pre-defined libraries with scale factor 0.9996 rather than the correct value of 0.9996012717). Thus, it allows data operations tests to be conducted using definitions that are controlled by the tester.

Secondly, EPSG CRS, conversion and transformation data is associated with an area of applicability; i.e. it should be limited in usage to within a specific geographic area. In principle, this "extent" data should be used by the geoscience software to limit CRS or operation use (e.g. to prevent the use of the British National Grid outside of Britain). However for some GIGS test procedures the test data deliberately exceeds the normal area of use for that data. For example, projection methods are tested beyond the usual extent of use of the method. Similarly, tests are run to establish to which of overlapping Canadian and US transformation data the software defaults. For this reason, the GIGS geodetic test data is deliberately not constrained to the limits of the equivalent real world data documented in the EPSG Dataset. The GIGS geodetic test data is given names specifically for the GIGS project, for example GIGS projCRS F7. This is equivalent to the GDA94/MGA zone 54 CRS except that F7 is not bounded by "extent" data. Similarly, the GIGS geogCRS J is equivalent to the NAD27 Geographic 2D CRS but without the associated "extent" data. This process allows fictitious areas of use to be associated with the GIGS systems in geoscience software that does recognise the EPSG area of use "extent" data.

1 *Note: in preliminary drafts of the GIGS documentation there was an exact correlation between test number and number within the test data file. This exact correlation has been lost as the tests and their numbering in 430-part 2 have been modified.*

Thirdly, the CRS WGS 84/British National Grid[3] is used in the test dataset as a common CRS in which to present the test data. This was chosen deliberately for test purposes to allow full testing of the coordinate operations in Series 5100 and 5200 and also to minimise the number of projects that need to be created for the Series 5300 through Series 5500 tests. This GIGS CRS has no real-world equivalent.

The precision of the defining parameters for all GIGS geodetic entities is identical to that in the equivalent data within the EPSG Dataset. To simplify usage and minimise confusion, clear descriptions and definitions of all special GIGS datums, geographic CRSs and projected CRSs have been tabulated and cross-referenced against their corresponding EPSG names that have the limited "area of use" extent. This has been done within each of the GIGS test data files and these mappings are separately tabulated in Appendix A.3 of this document. Testing for geographic applicability has to date not been included in the data tests, other than for NADCON and NTv2 gridded transformations across the US-Canadian border, but the test data allow for such testing in the future, should this be desirable.

1.5 Geoscience software projects and their geodetic definitions

For the Data Operations tests, test data must be loaded into the geoscience software. This will normally require the creation of a project within the software. To comply with the test scenarios these projects need to reference specified coordinate reference systems. To identify the project to which data is to be loaded, GIGS project names have been constructed, with project names made up from the required horizontal and vertical GIGS CRS names. For example, "GIGS project A9V1depth" is to be referenced to horizontal CRS "A9" and vertical CRS "V1 depth". The project CRSs are further detailed in Appendix A.4. The GIGS project names are referenced in the following text as for example *GIGS_project_A9V1depth*.

3 *The British National Grid was defined by Great Britain's national mapping agency to be referenced to the OSGB 1936 datum. Although we can mathematically link it to the WGS 84 datum, it is never actually used in that way nor is it defined in the EPSG Geodetic Parameter Registry in that way. Hence, WGS 84/British National Grid in thereal world does not exist and should not be used outside of these test procedures.*

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2 – Test data and procedures – geodetic definitions

2.1 Series 2000 – pre-defined geodetic parameter library

The tests for this series are designed to verify the correctness of geodetic parameters that are delivered with the software. The comparison to be taken as truth is the EPSG Dataset.

> *Note: The latest version of the EPSG Dataset should be used for these tests. See* www.epsg.org.

Records in the EPSG Dataset which have been deprecated should be ignored in Series 2000 testing (Deprecation is examined in Series 7000).

The test data files for Series 2000 describe a subset of EPSG records which is of particular interest to the E&P industry. They constitute the minimum set of definitions which should be checked. Testers are encouraged to go beyond this minimum set and verify the software's complete pre-defined geodetic parameter library against the EPSG Dataset, but this is not a requirement.

The Series 2000 tests are structured to follow the ISO 19111 and EPSG data models for spatial referencing by coordinates. This may be envisaged as a hierarchical series of entities, with higher-level entities being dependent upon lower-level entities. For example, a geodetic datum (higher level) includes an ellipsoid (lower level) with the datum dependent upon that ellipsoid definition. The higher level entity in this pairing may then be a lower level in a later pairing, for example a geodetic CRS (higher level) includes a geodetic datum (lower level). Lower level entities may be used in one or many higher level entities. The tests begin at the bottom of the hierarchy.

See Appendix A.2 for tips for conducting these tests in geoscience software in which the storage of geodetic parameters does not conform to the EPSG model and/or EPSG nomenclature.

The test data for these Series 2000 tests are all MS Excel 2003 (.xls) files.

Test procedure:	**GIGS 2001. Reference Units of Measure.**
Test purpose:	To verify reference units of measure bundled with the geoscience software.
Test method:	Compare unit definitions included in the software against the EPSG Dataset.
Test data:	EPSG Dataset and file *GIGS_2001_libUnit_[version_date].xls*. As a minimum those units included within file *GIGS_2001_libUnit_[version_date].xls* should be examined. This file contains three separate blocks of data for linear units, angular units and scaling units. It gives the EPSG code and name for the unit of measure, together with the ratio of the unit to the ISO base unit for that unit type.
Expected results:	Unit of measure definitions bundled with software should have the same name and ratio to the appropriate base unit as in the EPSG Dataset. See current version of the EPSG Dataset and (for core units) file *GIGS_2001_libUnit_[version_date].xls*. The values of the base unit per unit should be correct to at least 10 significant figures. Units missing from the software or included in the software additional to those in the EPSG Dataset or at variance with those in the EPSG Dataset should be reported.
Issues:	• Software may not recognise the diversity of units of measure encountered in geodetic definitions and coordinates. Particular attention should be given to whether the software distinguishes between different types of feet and supports different representations for degrees. • The ratio to base unit may be embedded in software code and not readily available to users. If this is the case, it may be possible to convert a coordinate set in base unit to the desired unit to compute the effective ratio to base unit. Otherwise, report that the conversion ratio cannot be determined.

Test procedure:	**GIGS 2002. Reference ellipsoid.**
Test purpose:	To verify reference ellipsoid parameters bundled with the geoscience software.
Test method:	Compare ellipsoid definitions included in the software against the EPSG Dataset.
Test data:	EPSG Dataset and file *GIGS_2002_libEllipsoid_[version_date].xls*. As a minimum those ellipsoids marked in *GIGS_2002_libEllipsoid_[version_date].xls* as being particularly important to the E&P industry should be examined. This file gives the EPSG code and name for the ellipsoid, commonly encountered alternative name(s) for the same object, the value and units for the semi-major axis, the conversion ratio to metres for these units, and then a second parameter which will be either the value of the inverse flattening (unitless) or the value of the semi-minor axis (in the same units as the semi-major axis). It may additionally contain a flag to indicate that the figure is a sphere: without this flag the figure is an oblate ellipsoid.
Expected results:	Ellipsoid definitions bundled with software, if any, should have same name and defining parameters as in the EPSG Dataset. See current version of the EPSG Dataset and file *GIGS_2002_libEllipsoid_[version_date].xls*. Equivalent alternative parameters are acceptable but should be reported. The values of the parameters should be correct to at least 10 significant figures. For ellipsoids defined by Clarke and Everest, as well as those adopted by IUGG as International, several variants exist. These must be clearly distinguished. Ellipsoids missing from the software or included in the software additional to those in the EPSG Dataset or at variance with those in the EPSG Dataset should be reported.
Issues:	• The term spheroid may be used in software documentation. Ellipsoid is the preferred term • Some geoscience software requires or uses different defining parameters to a and 1/f, for example e, e^2 or n. If necessary the values of these alternative parameters should be calculated from those given in the EPSG Dataset using standard formulae available in EPSG Guidance Note 7 part 2 or in geodetic texts. (Where the second parameter is the semi-minor axis b and the figure is an ellipsoid, the derived value of inverse flattening is given in the EPSG Dataset ellipsoid forms and reports). • If the figure is a sphere, 1/f is indeterminate and is not used. • Some geoscience software requires that all ellipsoid axes are defined using (international) metres. The metric equivalent of those given in the EPSG Dataset in other units may be derived using the appropriate conversion factor taken from the EPSG units definitions; the equivalent metric semi-major axes are given in file *GIGS_2002_libEllipsoid_[version_date].xls*.

Test procedure:	**GIGS 2003. Reference prime meridians.**
Test purpose:	To verify reference prime meridians bundled with the geoscience software.
Test method:	Compare prime meridian definitions included in the software against the EPSG Dataset.
Test data:	EPSG Dataset and file *GIGS_2003_libPrimeMeridian_[version_date].xls*. As a minimum those prime meridians shown in *GIGS_2003_libPrimeMeridian_[version_date].xls* as being particularly important to the E&P industry should be examined.
Expected results:	Prime meridian definitions bundled with the software should have the same name and Greenwich Longitude as in the EPSG Dataset. See current version of the EPSG Dataset and file *GIGS_2003_libPrimeMeridian_[version_date].xls*. Equivalent alternative units are acceptable but should be reported. The values of the Greenwich Longitude should be correct to at least 7 decimal places (of degrees or grads). Meridians missing from the software or included in the software additional to those in the EPSG Dataset or at variance with those in the EPSG Dataset should be reported.
Issues:	• Some geoscience software may not identify prime meridians. In this case it should be assumed that they must be Greenwich. • Offsets are positive when the subject prime meridian is east of the Greenwich meridian and negative when west of the Greenwich meridian. • Software may require that all offsets from Greenwich are defined using (decimal) degrees. The decimal degree equivalents of the preferred symbolised sexagesimal format are also included within the test file.

Test procedure:	**GIGS 2004. Reference geodetic datums/geodetic CRSs.**
Test purpose:	To verify reference geodetic datums and CRSs bundled with the geoscience software.
Test method:	Compare geodetic datum and geocentric, geographic 3D and geographic 2D CRS definitions included in the geoscience software against the EPSG Dataset.
Test data:	EPSG Dataset and file *GIGS_2004_libGeodeticDatumCRS_[version_date].xls*. As a minimum those datums and associated CRSs shown in *GIGS_2004_libGeodeticDatumCRS_[version_date].xls* as being particularly important to the E&P industry should be examined. Tests for component logical consistency should be included: for example, if a higher-level library-defined component such as ED50 datum is selected it should then not be possible to change any of its lower-level components such as the ellipsoid from the pre-defined value (in this example International 1924).
Expected results:	Definitions bundled with the software should have the same name and associated ellipsoid and prime meridian as in the EPSG Dataset. CRSs missing from the software or included in the geoscience software additional to those in the EPSG Dataset or at variance with those in the EPSG Dataset should be reported.
Issues:	• Critical data are correct: CRS and geodetic datum name, ellipsoid name and parameter values, and prime meridian name and Greenwich Longitude value. • EPSG Dataset geodetic CRS entries should have Cartesian axes in order X, Y, Z and ellipsoidal axes in order latitude, longitude, [ellipsoidal height]. The CRS axis order should agree with that in the EPSG dataset. • CRSs with the same datum but differing coordinate system attributes (in particular axes order) are considered to be different CRSs. Occurrences should be reported. • Some geoscience software may associate a transformation (to WGS 84) with a datum definition. This is not part of an EPSG datum or CRS definition and if present should be commented upon. See also test procedure GIGS 2007.

Test procedure:	**GIGS 2005. Reference map projections.**
Test purpose:	To verify reference map projections bundled with the geoscience software.
Test method:	Compare map projection definitions included in the software against the EPSG Dataset.
Test data:	EPSG Dataset and file *GIGS_2005_libProjection_[version_date].xls*. As a minimum those map projections included within file *GIGS_2005_libProjection_[version_date].xls* should be examined in detail. For zoned map projections the EPSG code range is given; each zone should be checked.
Expected results:	Map projection definitions bundled with the software should have the same name, method name, defining parameters and parameter values as in the EPSG Dataset. See current version of the EPSG Dataset. The values of the parameters should be correct to at least 10 significant figures. Map projections missing from the software or included in the software additional to those in the EPSG Dataset or at variance with those in the EPSG Dataset should be reported.
Issues:	• Critical data are correct name, method name, parameters and their values. • Some geoscience software requires that all projection parameters are defined using specific units. The equivalent of those given in the EPSG Dataset in other units may be derived using the appropriate conversion factor taken from the EPSG units definitions.

Test procedure:	**GIGS 2006. Reference projected CRSs.**
Test purpose:	To verify reference projected CRSs bundled with the geoscience software.
Test method:	Compare projected CRS definitions included in the software against the EPSG Dataset.
Test data:	EPSG Dataset and file *GIGS_2006_libProjectedCRS_[version_date].xls*. As a minimum those map projections included within file *GIGS_2006_libProjectedCRS_[version_date].xls* should be examined in detail.
Expected results:	Projected CRS definitions bundled with the software should have the same name, coordinate system (including units and axes abbreviations and axes order) and map projection as in the EPSG Dataset. See current version of the EPSG Dataset. CRSs missing from the software or included in the software additional to those in the EPSG Dataset or at variance with those in the EPSG Dataset should be reported.
Issues:	• Critical data are correct name and associated datum, coordinate system and map projection. • The EPSG Dataset projected CRS entries are specific regarding axes order, axes name/ abbreviation and axes units. CRSs with the same datum and projection but differing coordinate system attributes (particularly axes order and units) are considered to be different CRSs. Variances from EPSG should be reported. • Some geoscience software may associate a transformation (to WGS 84) with a datum definition. This is not part of an EPSG datum or CRS definition and if present should be commented upon.

Test procedure:	**GIGS 2007. Reference coordinate transformations.**
Test purpose:	To verify reference coordinate transformations bundled with the geoscience software.
Test method:	Compare transformation definitions included in the software against the EPSG Dataset.
Test data:	EPSG Dataset and file *GIGS_2007_libGeodTfm_[version_date].xls*. As a minimum those transformations included within file *GIGS_2007_libGeodTfm_[version_date].xls* should be examined.
Expected results:	Transformation definitions bundled with the software should have the same name, method name, defining parameters and parameter values as in EPSG Dataset. See current version of the EPSG Dataset. The values of the parameters should be correct to at least 10 significant figures. Transformations missing from the software or included in the software additional to those in the EPSG Dataset or at variance with those in the EPSG Dataset should be reported.
Issues:	• Critical data are correct name, method name, parameters and their values. • Some geoscience software requires that all transformation parameters are defined using specific units. The equivalent of those given in the EPSG Dataset in other units may be derived using the appropriate conversion factor taken from the EPSG units definitions. • Some geoscience software may associate a transformation (to WGS 84) with a datum definition. This is not part of an EPSG datum or CRS definition and if present should be commented upon. See test procedure GIGS 2004.

Test procedure:	**GIGS 2008. Reference vertical datums/vertical CRSs.**
Test purpose:	To verify reference vertical datums and CRSs bundled with the geoscience software.
Test method:	Compare vertical datum and CRS definitions included in the software against the EPSG Dataset.
Test data:	EPSG Dataset and file *GIGS_2008_libVerticalDatum_[version_date].xls*. As a minimum those datums and associated CRSs included within file *GIGS_2008_libVerticalDatum_[version_date].xls* should be examined.
Expected results:	Definitions bundled with the software should have the same name and coordinate system (including axes direction and units) as in EPSG Dataset. See current version of the EPSG Dataset. CRSs missing from the software or included in the software additional to those in the EPSG Dataset or at variance with those in the EPSG Dataset should be reported.
Issues:	• Critical data is correct CRS and datum name and axes direction, units and abbreviation. • The EPSG Dataset vertical CRS entries are specific regarding axes name/abbreviation and axes units. CRSs with the same datum but differing coordinate system attributes are considered to be different CRSs.

Test procedure:	**GIGS 2009. Reference vertical transformations.**
Test purpose:	To verify reference vertical transformations bundled with the geoscience software.
Test method:	Compare transformation definitions included in the software against the EPSG Dataset.
Test data:	EPSG Dataset and file *GIGS_2009_libVertTfm_[version_date].xls*. As a minimum those transformations included within file *GIGS_2009_libVertTfm_[version_date].xls* should be examined.
Expected results:	Transformation definitions bundled with the software should have same name, method name, defining parameters and parameter values as in EPSG Dataset. See current version of the EPSG Dataset. The values of the parameters should be correct to at least 10 significant figures. Transformations missing from the software or included in the software additional to those in the EPSG Dataset or at variance with those in the EPSG Dataset should be reported.
Issues:	• Critical data is correct name, method name, parameters and their values. • Some geoscience software requires that all transformation parameters are defined using specific units. The equivalent of those given in the EPSG Dataset in other units may be derived using the appropriate conversion factor taken from the EPSG units definitions. • Other vertical transformation methods exist that are currently not tested here. At this time these tests are not covered in the GIGS Test Dataset or associated Test Procedures, although they may be added at a later date.

2.2 Series 3000 – user-defined geodetic parameter library

The test procedures in this series are designed to evaluate the software's capabilities for adding user-defined CRS and transformation definitions to its geodetic parameter library. The test procedures presume that the software follows the ISO 19111 and EPSG geodetic data model. See Appendix A.2 for tips for conducting these tests in geoscience software in which the storage of geodetic parameters does not conform to the EPSG model and/or EPSG nomenclature.

The test procedures in this section should be conducted sequentially as some data loaded in early tests is required in later tests. The data may be envisaged as a hierarchical series of entities, with higher-level entities being dependent upon lower-level entities. For example, a geodetic datum (higher level) includes an ellipsoid (lower level) and the datum is dependent upon that ellipsoid definition. Lower level entities may be used in one or many higher level entities. The tests begin at the bottom of the entity hierarchy. The fully built-up CRSs and transformations are used for later tests, particularly those in Series 5000, Data Operations.

See section 1.4 above for comments on the names of geodetic entities created during these test procedures and Appendix A.3 for their mapping to real world entities documented in the EPSG Dataset.

If the software requires an area of use to be assigned to user-created geodetic entities, use the range +90 to -90 degrees latitude and +180 to -180 degrees longitude.

To cater for geoscience software using so-called "early binding" and requiring a transformation as part of the geodetic datum definition, the test data for each geodetic datum includes a default transformation to WGS 84. These default transformations deliberately use the geocentric translation method to ensure broadest applicability. Similarly, vertical datums are, in general, associated to mean sea level.

The test data for these Series 3000 tests are all MS Excel 2003 (.xls) files. The data is also distributed in an MS Access 2003 database.

Test procedure:	**GIGS 3001 - User-defined unit of measure**
Test purpose:	To verify that the software allows correct definition of a user-defined unit of measure.
Test method:	Create user-defined unit of measure for each of several different units.
Test data:	See file *GIGS_3001_userUnit_[version_date].xls.*
Expected results:	The software should accept the test data. The order in which the name and the unit factor are entered is not critical, although that given in the test dataset is recommended. Test result will be pass or fail. If fail, details of failure should be recorded.
Issues:	Units are defined relative to an ISO base unit: metre for length, radian for angle, unity for scale. These are included in the dataset for reference only. The expected input is the number of base units per unit. It may be described as a fraction formed from two values which EPSG refers to as factor B and factor C (numerator and denominator respectively). If necessary use the test data ratio as the numerator and unity as the denominator.

Test procedure:	**GIGS 3002 - User-defined ellipsoid**
Test purpose:	To verify that the software allows correct definition of a user-defined ellipsoid.
Test method:	Create user-defined ellipsoid for each of several different ellipsoids.
Test data:	See file *GIGS_3002_userEllipsoid_[version_date].xls.*
Expected results:	The software should accept the test data. The order in which the name and the ellipsoid parameters are entered is not critical, although that given in the test dataset is recommended. Test result will be pass or fail. If fail, details of failure should be recorded.
Issues:	• The term spheroid may be used in software documentation. Ellipsoid is the preferred term. • Some geoscience software requires or uses different defining parameters to 1/f or b, for example e, e^2 or n. If necessary the values of these alternative parameters should be calculated from those given in the EPSG Dataset using standard formulae available in EPSG Guidance Note 7, part 2 or geodetic texts. • Some geoscience software requires that all ellipsoid axes are defined using (international) metres. The metric equivalent of test data non-metric values can be obtained using the unit conversion factor included in the test data. • Software that use only a and 1/f will be unable to define a sphere. • Software that use only a and b will be able to define a sphere by inputting the test data value of a for both a and b.

Test procedure:	**GIGS 3003 - User-defined prime meridian**
Test purpose:	To verify that the software allows correct definition of a user-defined prime meridian.
Test method:	Create user-defined prime meridian for each of several different meridians.
Test data:	See file *GIGS_3003_userPrimeMeridian_[version_date].xls*
Expected results:	The software should accept the test data. The order in which the name and the meridian parameters are entered is not critical, although that given in the test dataset is recommended. Test result will be pass or fail. If fail, details of failure should be recorded.
Issues:	• Offsets are positive when the subject prime meridian is east of the Greenwich meridian and negative when west of the Greenwich meridian. • Some parameter values in the test data are given in sexagesimal degrees. Where this is the case the equivalent value in decimal degrees is also given. If the software does not accept sexagesimal degrees at the user interface, this should be reported.

Test procedure:	**GIGS 3004 - User-defined geodetic datum and CRS**
Test purpose:	To verify that the software allows correct definition of a user-defined geodetic datum and geodetic CRS.
Test method:	Create user-defined geodetic datum for each of several different datums. Create user-defined geodetic CRS for each of several different CRSs.
Test data:	See file *GIGS_3004_userGeodeticDatumCRS_[version_date].xls.*
Expected results:	The software should accept the test data. The order in which the name and the meridian parameters are entered is not critical, although that given in the test dataset is recommended. Test result will be pass or fail. If fail, details of failure should be recorded.
Issues:	• A geodetic datum is comprised of its name, the ellipsoid it uses and the prime meridian it uses. The detailed geodetic definition of origin and orientation is not required. • As most datums use the Greenwich prime meridian it is acceptable for this to be the default. • A geodetic CRS is comprised of its name, a geodetic datum and a coordinate system giving axes names, order and units. EPSG characterises subtypes of geodetic CRS – geographic and geocentric – based on the coordinate system. • Some geoscience software may require that the datum definition includes a transformation to a standard CRS, normally WGS 84. See test procedure GIGS 3007.

Test procedure:	**GIGS 3005 - User-defined map projection**
Test purpose:	To verify that the software allows correct definition of a user-defined map projection.
Test method:	Create user-defined projection for each of several different map projections.
Test data:	See file *GIGS_3005_userProj_[version_date].xls.*
Expected results:	The geoscience software should accept the test data. The order in which the name and the projection parameters are entered is not critical, although that given in the test dataset is recommended. Test result will be pass or fail. If fail, details of failure should be recorded.
Issues:	• Each map projection method requires specific parameters (see EPSG Dataset for details). All parameters should be variables. Some software hardwires the values of (some of) these variables; e.g., scale factor must be 1.0, scale factor must be 0.9996, latitude of origin must be 0 degrees, etc. The data for this test have no "standard" values. Latitudes are positive north, negative south; longitudes positive east, negative west. Several different map projections are to be tested. • Some parameter values in the test data are given in sexagesimal degrees. Where this is the case the equivalent value in decimal degrees is also given. If the software does not accept sexagesimal degrees at the user interface, this should be reported.

Test procedure:	**GIGS 3006 - User-defined projected CRS**
Test purpose:	To verify that the software allows correct definition of a user-defined projected CRS.
Test method:	Create user-defined projected CRS for each of several different CRSs.
Test data:	See file *GIGS_3006_userProjectedCRS_[version_date].xls.*
Expected results:	The software should accept the test data. The order in which the name and the projection parameters are entered is not critical, although that given in the test dataset is recommended. Test result will be pass or fail. If fail, details of failure should be recorded.
Issues:	• A projected CRS is comprised of its name, a geodetic datum, a map projection and a coordinate system giving axes names, order and units. • The coordinate system is defined within the projected CRS test data file; in the ISO/EPSG model it is a separate entity. • The projected CRS units may not be the same as those of its components. • Some geoscience software may require that the datum definition includes a transformation to a standard CRS, normally WGS 84. This requirement may be inherited by projected CRSs. See test procedures GIGS 3004 and GIGS 3007.

Test procedure:	**GIGS 3007 - User-defined coordinate transformation**
Test purpose:	To verify that the software allows correct definition of a user-defined coordinate transformation.
Test method:	Create user-defined coordinate transformation for each of several different coordinate transformation methods.
Test data:	See file *GIGS_3007_userGeodTfm_[version_date].xls.*
Expected results:	The software should accept the test data. The order in which the name and the coordinate transformation parameters are entered is not critical, although that given in the test dataset is recommended. Test result will be pass or fail. If fail, details of failure should be recorded.
Issues:	• Each coordinate transformation method requires specific parameters (see EPSG Dataset for details). All parameters should be variables. Their units may vary. Several different coordinate transformations are to be tested. • Some geoscience software may require that a datum definition includes a transformation to a standard CRS, normally WGS 84. If this is the case treat this test as part of test procedure 3004 and report the fact. • Some parameter values in the test data are given in sexagesimal degrees. Where this is the case the equivalent value in decimal degrees is also given. If the software does not accept sexagesimal degrees at the user interface, this should be reported.

Test procedure:	**GIGS 3008 - User-defined vertical datum and CRS**
Test purpose:	To verify that the software allows correct definition of a user-defined vertical datum and CRS.
Test method:	Create user-defined geodetic datum for each of several different datums. Create user-defined geodetic CRS for each of several different CRSs.
Test data:	See file *GIGS_3008_userVertCRS_[version_date].xls.*
Expected results:	The software should accept the test data. The order in which the name and the components are entered is not critical, although that given in the test dataset is recommended. Test result will be pass or fail. If fail, details of failure should be recorded.
Issues:	• A vertical CRS is comprised of its name, a vertical datum, a map projection and a coordinate system giving axes names, order and units. • The vertical CRS units may not be the same as those of its components. • Some geoscience software may require that the vertical datum definition includes a transformation to a standard CRS, normally unspecified mean sea level. This requirement may be inherited by vertical CRSs. See test procedure GIGS 3009.

Test procedure:	**GIGS 3009 - User-defined vertical coordinate transformation**
Test purpose:	To verify that the software allows correct definition of a user-defined vertical coordinate transformation.
Test method:	Create user-defined coordinate transformation for each of several different transformation methods.
Test data:	See file *GIGS_3009_userVertTfm_[version_date].xls.*
Expected results:	The software should accept the test data. The order in which the name and the coordinate transformation parameters are entered is not critical, although that given in the test dataset is recommended. Test result will be pass or fail. If fail, details of failure should be recorded.
Issues:	• Each coordinate transformation method requires specific parameters (see EPSG Dataset for details). All parameters should be variables. Their units may vary. Several different coordinate transformations are to be tested. • Some geoscience software may require that a datum definition includes a transformation to a standard vertical datum, normally (non-specific) mean sea level. If this is the case treat this test as part of test procedure 308 and report the fact. • Some parameter values in the test data are given in sexagesimal degrees. Where this is the case the equivalent value in decimal degrees is also given. If the software does not accept sexagesimal degrees at the user interface, this should be reported.

Test procedure:	**GIGS 3010 - User-defined concatenated coordinate transformation**
Test purpose:	To verify that the software allows correct definition of a user-defined concatenated coordinate transformation.
Test method:	Create user-defined concatenated coordinate transformation for each of several different transformations.
Test data:	See file *GIGS_3010_userConcatTfm_[version_date].xls.*
Expected results:	The software should accept the test data. The order in which the steps of the concatenated coordinate transformation are entered is not critical as long as the step number is correct, although that given in the test dataset is recommended. Test result will be pass or fail. If fail, details of failure should be recorded.
Issues:	• The coordinate transformations in the GIGS Test Dataset file *GIGS_3010_userConcatTfm_[version_date].xls* use steps constructed during test 3007. • (The reversing of source and target CRSs in individual steps is not tested).

3 – Test data and procedures – coordinate conversions & transformations

3.1 General

Test data sets have been produced for the conversion and transformation methods in the EPSG Dataset identified in the GIGS project as being high or medium priority for E&P. Table 1 below lists the included methods and also notes the mechanism used for calculating the test point data. In most cases, spreadsheets developed by OGP for verifying formulae published in OGP Guidance Note 7, part 2, have been used. Additionally all of the conversion and transformation test data have been rigorously verified using independently sourced geodetic software.

Table 1 – Coordinate conversion and transformation methods included in the GIGS Test Dataset

EPSG Method Name	EPSG Method Code	Calculation Method for Test Data
Transverse Mercator	9807	EPSG spreadsheet[4]
Lambert Conic Conformal (1SP)	9801	EPSG spreadsheet
Lambert Conic Conformal (2SP)	9802	EPSG spreadsheet
Oblique Stereographic	9809	EPSG spreadsheet
Hotine Oblique Mercator (variant A)	9812	EPSG spreadsheet
Hotine Oblique Mercator (variant B)	9815	EPSG spreadsheet
American Polyconic	9818	EPSG spreadsheet
Cassini-Soldner	9806	EPSG spreadsheet
Albers Equal Area	9822	Geomatrix
Lambert Azimuthal Equal Area	9820	EPSG spreadsheet
Mercator (variant A)	9804	EPSG spreadsheet
Mercator (variant B)	9805	EPSG spreadsheet
Transverse Mercator (South Orientated)	9808	EPSG spreadsheet
Geographic/geocentric conversions	9602	EPSG spreadsheet
Geocentric translations (geocentric domain)	1031	EPSG spreadsheet
Geocentric translations (geog2D domain)	9603	EPSG spreadsheet
Geocentric translations (geog3D domain)	1035	EPSG spreadsheet
Abridged Molodensky	9605	EPSG spreadsheet
Position Vector transformation (geog2D domain)	9606	EPSG spreadsheet
Position Vector transformation (geog3D domain)	1037	EPSG spreadsheet
Coordinate Frame Rotation (geog2D domain)	9607	EPSG spreadsheet
Coordinate Frame Rotation (geog3D domain)	1038	EPSG spreadsheet
Molodensky-Badekas (geog2D domain)	9636	EPSG spreadsheet
Molodensky-Badekas (geog3D domain)	1039	EPSG spreadsheet
NADCON	9613	US National Geodetic Survey (NGS) online calculator
NTv2	9615	Natural Resources Canada and Land Victoria (Australia) online calculators
Longitude rotation	9601	Manual
UKOOA P6 seismic bin grid transformation	9666	EPSG spreadsheet
Vertical Offset	9616	EPSG spreadsheet

The method names follow those in the EPSG Dataset. If the software does not follow this recommended method naming, see the individual test procedure descriptions that follow for tips

4 *These EPSG spreadsheets were constructed for verifying the formulae published in OGP Guidance Note 7-2 (OGP Report № 373-7-2) and are not publicly availble.*

for some commonly encountered alternative names for the same method. Software is not required to use the formulae published by EPSG, but its algorithms are expected to give results which are not significantly different to those from the EPSG formulae. Tests for which the method is not supported by the software should be considered to have failed and should be so reported.

Tests for map projections are described in Test Series 5100, with coordinate transformations and other conversions in Test Series 5200. Other than segregating map projections from other coordinate operations, there is no significance to this sectioning

The test datasets are built in the expectation of testing methods individually. This will not test software behaviour for selection of coordinate transformation when several variants using different methods might be available, for example in Australia where low, medium and high accuracy methods are promoted using 3-parameter geocentric translation, 7-parameter coordinate frame and NTv2 methods respectively. Software might not allow a user to override the use of a higher accuracy method with a coordinate transformation using a lower accuracy method. This should be investigated without a specific test data set.

The test data for these Series 5100 and Series 5200 tests are in Excel spreadsheet v2003 files (.xls). Input data for each test procedure is in a separate file. There is a single spreadsheet containing separate worksheets for output of each of the series. The file names distinguish input and output data.

Each input file contains brief instructions. These are supplemented by the test procedure descriptions in this document. The test input files contain a variable number of header records containing a comment followed by separate columns of data for forward and reverse computations. Each point is on a separate row. Points to be input for the forward and reverse calculations are generally interleaved in adjacent rows. In some cases there may be multiple test scenarios within one file, represented by several blocks of data. All points in the input file should be tested in the direction dictated by the input columns. The results should be compared with that given in the output file. Round trip calculations from the converted coordinates back to the original should also be tested for the point or points indicated in the input file, with final coordinates compared to the starting values.

Coordinates of test points are given in the order and units that are described in the CRS definition. Latitude and longitude are usually given in sexagesimal degree representation, but a decimal equivalent is provided in the test data in separate columns. Decimal degree values for latitude are positive for the northern hemisphere, negative for the southern hemisphere, and values for longitude are positive for the eastern hemisphere, negative for the western hemisphere.

The coordinate reference systems to which input and output coordinates are referenced are given in input and output file column headings. The use of special GIGS geodetic entities created in the Series 3000 tests is deliberate. Should software fail the Series 3000 tests and have passed the Series 2000 tests it should still be possible to run this series of tests.

Each test data sets comprises a small number of points. For most tests the test data points are laid out in two perpendicular transects. These transects avoid the system origin. When considered appropriate, additional points or transects have been added. The test points are divided into two subsets and data for testing both forward and reverse cases have been generated. The tests investigate computational behaviour of the method within and slightly beyond the reasonable area of use. In general, possible failure points at "difficult" points such as a geographic pole, have not been included. Nor have the test points been extended well away from a practical and reasonable "area of use". The test datasets are not exhaustive. Developers are expected to augment the data to test frequently encountered failure conditions (boundary conditions, etc). Precision of test data is further described in Appendix A.5.

The test procedures in the 5100 and 5200 series are designed for the conversion of individual points. If the software does not have the functionality to allow this it may be necessary to first create a project for each test procedure and to load the test points as if they were the locations of geoscience data. For the 5100 series map projection tests the project CRS should be that of the

projected CRS defined in the test procedure. For the 5200 series tests the project CRS could be either the source CRS or the target CRS defined in the test procedure.

3.2 Series 5100 – map projections

Test procedure:	**GIGS 5101. Transverse Mercator conversions.**
Test purpose:	To verify that conversions for the Transverse Mercator map projection method are consistent with EPSG.
Test method:	Invoke coordinate conversion and inspect results.
Test data:	*GIGS_mapProj_5101_TM_input_[version_date].xls*. This file includes (separate) data for forward and reverse calculations. Because of the importance of the Transverse Mercator projection method, this test is more extensive than for other methods. The test data is in four parts, one for each hemisphere quadrant.
Expected results:	Results for the forward and reverse calculations should agree to within 0.03m or 0.001″ of the test data. See file *GIGS_mapProj_51xx_output_[version_date].xls*, worksheet 5101 TM. For the round trip calculation the initial coordinates of the point should change by less than 0.0002″ or 6mm after 1000 iterations. Test result will be pass or fail. If fail, details of failure should be recorded.
Issues:	EPSG considers this method to embrace Gauss-Boaga and (with all five TM parameters as variables and suitable parameter values) Gauss-Kruger. If geoscience software allows these methods they should be included in this test procedure. EPSG publishes two sets of formulae for the TM method. USGS formulae are known to break down for points more than 4° from the central meridian (longitude of origin). The JHS formulae are robust to at least 30° and although use of the projection at those distances is not recommend the JHS formulae are preferred. Results from both formulae are included in the test data.

Test procedure:	**GIGS 5102. Lambert Conic Conformal (1SP[5]) conversions.**
Test purpose:	To verify that conversions for the Transverse Mercator map projection method are consistent with EPSG.
Test method:	Invoke coordinate conversion and inspect results.
Test data:	*GIGS_mapProj_5101_TM_input_[version_date].xls*. This file includes (separate) data for forward and reverse calculations. Because of the importance of the Transverse Mercator projection method, this test is more extensive than for other methods. The test data is in four parts, one for each hemisphere quadrant.
Expected results:	Results for the forward and reverse calculations should agree to within 0.03m or 0.001″ of the test data. See file *GIGS_mapProj_51xx_output_[version_date].xls*, worksheet 5101 TM. For the round trip calculation the initial coordinates of the point should change by less than 0.0002″ or 6mm after 1000 iterations. Test result will be pass or fail. If fail, details of failure should be recorded.
Issues:	EPSG considers this method to embrace Gauss-Boaga and (with all five TM parameters as variables and suitable parameter values) Gauss-Kruger. If geoscience software allows these methods they should be included in this test procedure. EPSG publishes two sets of formulae for the TM method. USGS formulae are known to break down for points more than 4° from the central meridian (longitude of origin). The JHS formulae are robust to at least 30° and although use of the projection at those distances is not recommend the JHS formulae are preferred. Results from both formulae are included in the test data.

Test procedure:	**GIGS 5103. Lambert Conic Conformal (2SP[6]) conversions.**
Test purpose:	To verify that conversions for the Lambert Conic Conformal (2SP) map projection method are consistent with EPSG.
Test method:	Invoke coordinate conversion and inspect results.
Test data:	*GIGS_mapProj_5103_LCC2_input_[version_date].xls*. This file includes (separate) data for forward and reverse calculations The test is in three parts, in which the grid coordinates are in different units.
Expected results:	Results should agree to within 0.03m or 0.001″ of the test data. See file *GIGS_mapProj_51xx_output_[version_date].xls*, worksheet 5103 LCC2. For the round trip calculation the initial coordinates of the point should change by less than 0.0002″ or 6mm after 1000 iterations. Test result will be pass or fail. If fail, details of failure should be recorded.
Issues:	

5 1SP means one standard parallel is used in the map projection definition.
6 2SP means two standard parallels are used in the map projection definition.

Test procedure:	**GIGS 5104. Oblique Stereographic conversions.**
Test purpose:	To verify that conversions for the Oblique Stereographic map projection method are consistent with EPSG.
Test method:	Invoke coordinate conversion and inspect results.
Test data:	*GIGS_mapProj_5104_Stereo_input_[version_date].xls*. This file includes (separate) data for forward and reverse calculations.
Expected results:	Results should agree to within 0.05m or 0.002" of the test data. See file *GIGS_mapProj_51xx_output_[version_date].xls*, worksheet 5104 OblStereo. For the round trip calculation the initial coordinates of the point should change by less than 0.0002" or 6mm after 1000 iterations. Test result will be pass or fail. If fail, details of failure should be recorded.
Issues:	There are two significantly different approaches to the handling of the ellipsoidal development of this map projection method which are often not clearly distinguished through the method name. These give significantly different results away from the projection origin and should be considered to be different methods. In some geoscience software the method called 'Double Stereographic' equates to the EPSG Oblique Stereographic method.

Test procedure:	**GIGS 5105. Hotine Oblique Mercator (variant B) conversions.**
Test purpose:	To verify that conversions for the Hotine Oblique Mercator (variant B) map projection method are consistent with EPSG.
Test method:	Invoke coordinate conversion and inspect results.
Test data:	*GIGS_mapProj_5105_HOM-B_input_[version_date].xls*. This file includes (separate) data for forward and reverse calculations. This test is in two parts, testing oblique and 90° scenarios for the azimuth of the projection initial line. (The latter is a known problem area some software).
Expected results:	Results should agree to within 0.05m or 0.002" of the test data. See file *GIGS_mapProj_51xx_output_[version_date].xls*, worksheet 5105 HOM-B. For the round trip calculation the initial coordinates of the point should change by less than 0.0002" or 6mm after 1000 iterations. Test result will be pass or fail. If fail, details of failure should be recorded.
Issues:	Geoscience software may define the map projection in different ways. One variation is in the location at which false grid coordinates are applied. EPSG caters for two alternatives and considers these to be different methods – see test procedure 5106 below. Another variation involves the means by which the initial line is defined. EPSG requires an azimuth value. An alternative approach is to define this azimuth through the coordinates of two points; this approach is not catered for by EPSG.

Test procedure:	**GIGS 5106. Hotine Oblique Mercator (variant A) conversions.**
Test purpose:	To verify that conversions for the Hotine Oblique Mercator (variant A) map projection method are consistent with EPSG.
Test method:	Invoke coordinate conversion and inspect results.
Test data:	*GIGS_mapProj_5106_HOM-A_input_[version_date].xls*. This file includes (separate) data for forward and reverse calculations.
Expected results:	Results should agree to within 0.05m or 0.002" of the test data. See file *GIGS_mapProj_51xx_output_[version_date].xls*, worksheet 5106 HOM-A. For the round trip calculation the initial coordinates of the point should change by less than 0.0002" or 6mm after 1000 iterations. Test result will be pass or fail. If fail, details of failure should be recorded.
Issues:	Geoscience software may define the map projection in different ways. One variation is in the location at which false grid coordinates are applied. EPSG caters for two alternatives and considers these to be different methods – see test procedure 5105 above. Another variation involves the means by which the initial line is defined. EPSG requires an azimuth value. An alternative approach is to define this azimuth through the coordinates of two points; this approach is not catered for by EPSG.

Test procedure:	**GIGS 5107. American Polyconic conversions.**
Test purpose:	To verify that conversions for the American Polyconic map projection method are consistent with EPSG.
Test method:	Invoke coordinate conversion and inspect results.
Test data:	*GIGS_mapProj_5107_PolyC_input_[version_date].xls*. This file includes (separate) data for forward and reverse calculations.
Expected results:	Results should agree to within 0.05m or 0.002" of the test data. See file *GIGS_mapProj_51xx_output_[version_date].xls*, worksheet 5107 AmPolyC. For the round trip calculation the initial coordinates of the point should change by less than 0.0002" or 6mm after 1000 iterations. Test result will be pass or fail. If fail, details of failure should be recorded.
Issues:	There are numerous polyconic methods in the literature giving significantly different results. The method name "polyconic" is therefore ambiguous.

Test procedure:	**GIGS 5108. Cassini-Soldner conversions.**
Test purpose:	To verify that conversions for the Cassini-Soldner map projection method are consistent with EPSG.
Test method:	Invoke coordinate conversion and inspect results.
Test data:	*GIGS_mapProj_5108_Cass_input_[version_date].xls*. This file includes (separate) data for forward and reverse calculations.
Expected results:	Results should agree to within 0.05m or 0.002" of the test data. See file *GIGS_mapProj_51xx_output_[version_date].xls*, worksheet 5108 Cass. For the round trip calculation the initial coordinates of the point should change by less than 0.0002" or 6mm after 1000 iterations. Test result will be pass or fail. If fail, details of failure should be recorded.
Issues:	Method may be called "Cassini".

Test procedure:	**GIGS 5109. Albers Equal Area conversions.**
Test purpose:	To verify that conversions for the Albers Equal Area map projection method are consistent with EPSG.
Test method:	Invoke coordinate conversion and inspect results.
Test data:	*GIGS_mapProj_5109_Albers_input_[version_date].xls*. This file includes (separate) data for forward and reverse calculations.
Expected results:	Results should agree to within 0.05m or 0.002" of the test data. See file *GIGS_mapProj_51xx_output_[version_date].xls*, worksheet 5109 Albers. For the round trip calculation the initial coordinates of the point should change by less than 0.0002" or 6mm after 1000 iterations. Test result will be pass or fail. If fail, details of failure should be recorded.
Issues:	Method may be called "Albers".

Test procedure:	**GIGS 5110. Lambert Azimuthal Equal Area conversions.**
Test purpose:	To verify that conversions for the Lambert Azimuthal Equal Area map projection method are consistent with EPSG.
Test method:	Invoke coordinate conversion and inspect results.
Test data:	*GIGS_mapProj_5110_LAEA_input_[version_date].xls* This file includes (separate) data for forward and reverse calculations.
Expected results:	Results should agree to within 0.05m or 0.002" of the test data. See file GIGS_mapProj_51xx_output_[version_date].xls, worksheet 5110 LAEA. For the round trip calculation the initial coordinates of the point should change by less than 0.0002" or 6mm after 1000 iterations. Test result will be pass or fail. If fail, details of failure should be recorded.
Issues:	Method may be called "LAEA".

Test procedure:	**GIGS 5111. Mercator (variant A) conversions.**
Test purpose:	To verify that conversions for the Mercator (variant A) map projection method are consistent with EPSG.
Test method:	Invoke coordinate conversion and inspect results.
Test data:	*GIGS_mapProj_5111_MercA_input_[version_date].xls*. This file includes (separate) data for forward and reverse calculations. The test is in two parts, one using a geographic CRS based on the Greenwich meridian, the other using a non-Greenwich CRS.
Expected results:	Results should agree to within 0.05m or 0.002" of the test data. See file *GIGS_mapProj_51xx_output_[version_date].xls*, worksheet 5111 MercA. For the round trip calculation the initial coordinates of the point should change by less than 0.0002" or 6mm after 1000 iterations. Test result will be pass or fail. If fail, details of failure should be recorded.
Issues:	• Method may be called Mercator (1SP). • Part 2 uses a non-Greenwich prime meridian. Geoscience software may not handle CRSs using a prime meridian other than (by default) Greenwich. Should this be the case, this failure should be documented.

Test procedure:	**GIGS 5112. Mercator (variant B) conversions.**
Test purpose:	To verify that conversions for the Mercator (variant B) map projection method are consistent with EPSG.
Test method:	Invoke coordinate conversion and inspect results.
Test data:	*GIGS_mapProj_5112_MercB_input_[version_date].xls*. This file includes (separate) data for forward and reverse calculations.
Expected results:	Results should agree to within within 0.05m or 0.002" of the test data. See file *GIGS_mapProj_51xx_output_[version_date].xls*, worksheet 5112 MercB. For the round trip calculation the initial coordinates of the point should change by less than 0.0002" or 6mm after 1000 iterations. Test result will be pass or fail. If fail, details of failure should be recorded.
Issues:	• In EPSG literature prior to 2010 this method was previously called "Mercator (2SP)". However that name is ambiguous. See EPSG Guidance Note 7 part 2 October 2010 or later revision for further information on the variants for the Mercator method. • Software may support variant C rather than this variant B. Should that be the case the test may be run using a value of 0.0 for the "latitude of origin" defining parameter.

Test procedure:	**GIGS 5113. Transverse Mercator (South Orientated) conversions.**
Test purpose:	To verify that conversions for the Transverse Mercator (South Orientated) map projection method are consistent with EPSG.
Test method:	Invoke coordinate conversion and inspect results.
Test data:	*GIGS_mapProj_5113_TMSO_input_[version_date].xls*. This file includes (separate) data for forward and reverse calculations.
Expected results:	Results should agree to within 0.03m or 0.001" of the test data. See file *GIGS_mapProj_51xx_output_[version_date].xls*, worksheet 5113 TMSO. For the round trip calculation the initial coordinates of the point should change by less than 0.0002" 6mm after 1000 iterations. Test result will be pass or fail. If fail, details of failure should be recorded.
Issues:	Applicable to southern Africa.

3.3 Series 5200 – coordinate transformations and coordinate conversions other than map projections

Note: So-called "early binding" geoscience software will require the transformation to be defined as part of a CRS definition. The necessary transformations are given in Series 3000 test procedures GIGS 3007 (horizontal) and GIGS 3009 (vertical).

Test procedure:	**GIGS 5201. Geographic/geocentric conversions.**
Test purpose:	To verify that conversions for the geographic/geocentric method are consistent with EPSG method 9602 (Geographic/geocentric conversions).
Test method:	Invoke coordinate conversion and inspect results.
Test data:	*GIGS_conv_5201_GeogGeocen_input_[version_date].xls*. This file includes (separate) data for forward and reverse calculations.
Expected results:	Results should agree to within 0.01m/0.0003" of the test data. See file *GIGS_tfm_52xx_output_[version_date].xls*, worksheet 5201 GeogGeocen. For the round trip calculation the initial coordinates of the point should change by less than 6mm/0.0002" after 1000 iterations. Test result will be pass or fail. If fail, details of failure should be recorded.
Issues:	• Although technically a conversion, this method is most likely to be applicable only in geoscience software which can handle transformations and is therefore treated in this section. • Geoscience software may not handle geocentric Cartesian coordinates. Should this be the case, then this test cannot be conducted. The reason for failure should be stated. • The same test point input coordinates are used as input in test procedures GIGS 5201, 5203-5205 and 5211-5213. Output coordinates differ due to the different CRSs and transformations used in these tests.

Test procedure:	**GIGS 5203. Position Vector (geographic domain) transformations**
Test purpose:	To verify that transformations for the Position Vector 7-parameter transformation method which operate from and to geographic coordinates are consistent with EPSG methods. [Either the Position Vector transformation (geog2D domain), method 9606 or Position Vector transformation (geog3D domain) method 1037 is acceptable.]
Test method:	Invoke coordinate transformation and inspect results.
Test data:	*GIGS_tfm_5203_PosVec_input_[version_date].xls*. This file includes (separate) data for forward and reverse calculations.
Expected results:	Results should agree to within 0.001" of the test data. See file *GIGS_tfm_52xx_output_[version_date].xls*, worksheet 5203 PosVec. For the round trip calculation the initial coordinates of the point should change by less than 0.0002" after 1000 iterations. Test result will be pass or fail. If fail, details of failure should be recorded. Some geoscience software ignores ellipsoidal heights during these transformations (or set the input ellipsoidal heights to zero). If that is the case, results will match the results as shown for the geog2D case, EPSG method 9606. Horizontal coordinates obtained for those points with ellipsoidal heights significantly different from zero will be incorrect, whereas correct results may be generated for points with zero (or near zero) ellipsoidal heights. For large ellipsoidal heights (either positive or negative), the correct results are given by the geog3D EPSG method 1037 Which results are matched should be clearly documented in the report on the test results.
Issues:	• If the geoscience software does not appear to support this method but has one called "Helmert 7-parameter" or "Bursa Wolf", this may be it. • In practice coordinate transformation parameters are defined using a variety of units. The test data includes coordinate transformations of interest to the industry which use different units of measure. • The same test point input coordinates are used as input in test procedures GIGS 5201, 5203-5205 and 5211-5213. Output coordinates differ due to the different CRSs and coordinate transformations in these tests.

Test procedure:	**GIGS 5204. Coordinate Frame Rotation (geographic 2D domain) transformations.**
Test purpose:	To verify that transformations for the Coordinate Frame Rotation method which operate from and to geographic 2D coordinates are consistent with EPSG methods. [Either the Coordinate Frame Rotation (geog2D domain), method 9607 or Coordinate Frame Rotation (geog3D domain) method 1038 is acceptable.]
Test method:	Invoke coordinate transformation and inspect results.
Test data:	*GIGS_tfm_5204_CoordFrame_input_[version_date].xls*. This file includes (separate) data for forward and reverse calculations.
Expected results:	Results should agree to within 0.001" of the test data. See file *GIGS_tfm_52xx_output_[version_date].xls*, worksheet 5204 CoordFrame. For the round trip calculation the initial coordinates of the point should change by less than 0.0002" after 1000 iterations. Test result will be pass or fail. If fail, details of failure should be recorded. Some geoscience software ignores ellipsoidal heights during these transformations (or set the input ellipsoidal heights to zero).). If that is the case, results will match the results as shown for the geog2D case, EPSG method 9607. Horizontal coordinates obtained for those points with ellipsoidal heights significantly different from zero will be incorrect, whereas correct results may be generated for points with zero (or near zero) ellipsoidal heights. For large ellipsoidal heights (either positive or negative), the correct results are given by the geog3D EPSG method 1037. Which results are matched should be clearly documented in the report on the test results.
Issues:	• There are two opposing conventions for the sign of the rotations in 7-parameter geocentric transformations. EPSG distinguishes these as two discrete methods; see also test procedure 5203 above. Geoscience software may use only one of these conventions within its coordinate transformation engine but it is expected that it will accept coordinate transformation definitions for both methods and make the necessary adjustments internally. Should the software fail to make these adjustments the output will be incorrect. • If the geoscience software does not appear to support this method but has one called "Helmert 7-parameter" or "Bursa Wolf", this may be it. • The same test point input coordinates are used as input in test procedures GIGS 5201, 5203-5205 and 5211-5213. Output coordinates differ due to the different CRSs and coordinate transformations in these tests.

Test procedure:	**GIGS 5205. Molodensky-Badekas (geographic 2D domain) transformations.**
Test purpose:	To verify whether transformations for the Molodensky-Badekas method which operate from and to geographic 2D coordinates are consistent with EPSG methods. [Either the Molodensky-Badekas (geog2D domain), method 9636 or Molodensky-Badekas (geog3D domain) method 1039 is acceptable.].
Test method:	Invoke coordinate transformation and inspect results.
Test data:	*GIGS_tfm_5205_MolBad_input_[version_date].xls*. This file includes (separate) data for forward and reverse calculations.
Expected results:	Results should agree to within 0.001″ of the test data. See file *GIGS_tfm_52xx_output_[version_date].xls*, worksheet 5205 MolBad. For the round trip calculation the initial coordinates of the point should change by less than 0.0002″ after 1000 iterations. Test result will be pass or fail. If fail, details of failure should be recorded. Some geoscience software ignores ellipsoidal heights during these transformations (or set the input ellipsoidal heights to zero). If that is the case, results will match the results as shown for the geog2D case, EPSG method 9606. Horizontal coordinates obtained for those points with ellipsoidal heights significantly different from zero will be incorrect, whereas correct results may be generated for points with zero (or near zero) ellipsoidal heights. For large ellipsoidal heights (either positive or negative), the correct results are given by the geog3D EPSG method 1037. Which results are matched should be clearly documented in the report on the test results.
Issues:	• See test procedure GIGS 5212 for a similar test operating between geocentric coordinates. • The same test point input coordinates are used as input in test procedures GIGS 5201, 5203-5205 and 5211-5213. Output coordinates differ due to the different CRSs and coordinate transformations in these tests.

Test procedure:	**GIGS 5206. NADCON transformations.**
Test purpose:	To verify that coordinate transformations for the NADCON method are consistent with EPSG method 9613.
Test method:	Invoke coordinate transformation and inspect results.
Test data:	*GIGS_tfm_5206_NADCON_input_[version_date].xls*. This file includes (separate) data for forward and reverse calculations.
Expected results:	Results should agree to within 0.001″ of the test data. See file *GIGS_tfm_52xx_output_[version_date].xls*, worksheet 5206 NADCON. For the round trip calculation the initial coordinates of the point should change by less than 0.0002″ after 1000 iterations. Test result will be pass or fail. If fail, details of failure should be recorded.
Issues:	• This method uses longitudes positive to the west. This should be handled internally within the geoscience software, as the EPSG and ISO convention of longitudes positive east should be presented to users. • In North America there is overlap of NADCON and NTv2 grid coverage. For geoscience software including both methods, the results in the area of overlap should be checked. Some of the test points are in these overlap areas and are common with those in test procedure GIGS 5207. See figure 1 below. The expectation is that NADCON grids are used within the USA and NTv2 grids are used within Canada.

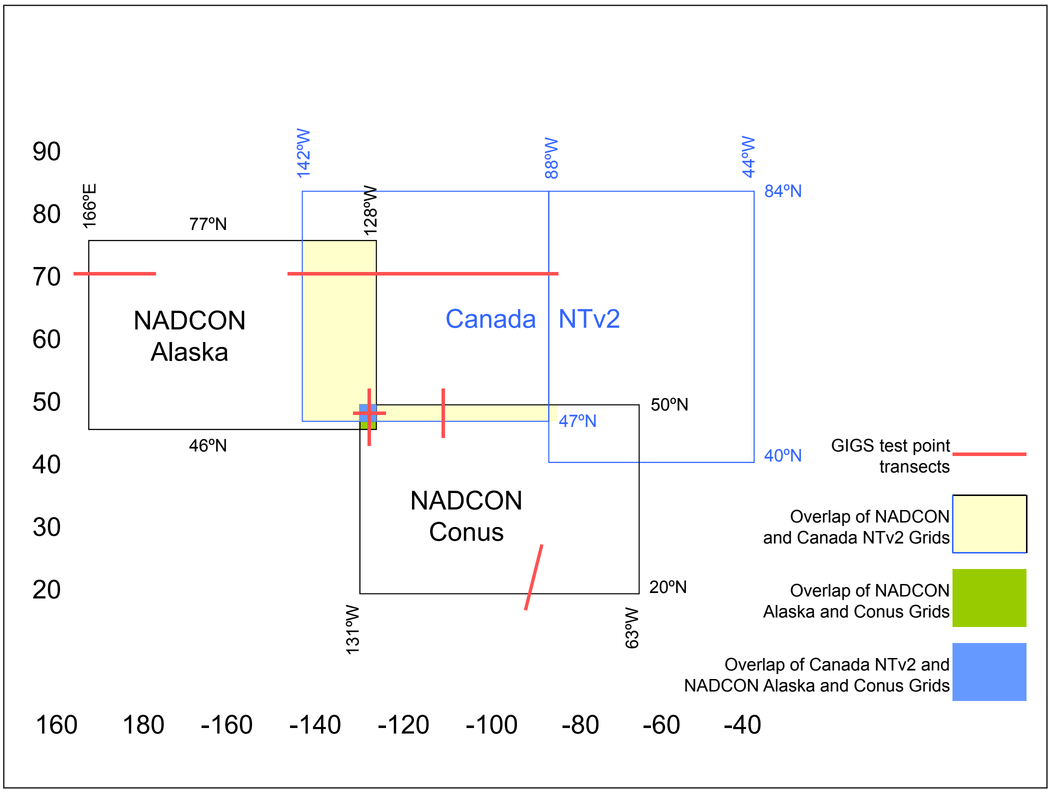

Figure 1 - GIGS tests for NTv2 and NADCON methods in relation to grid coverage

Test procedure:	**GIGS 5207. NTv2 transformations.**
Test purpose:	To verify that coordinate transformations for the NTv2 method are consistent with EPSG method 9615.
Test method:	Invoke coordinate transformation and inspect results.
Test data:	*GIGS_tfm_5207_NTv2_input_[version_date].xls*. This file includes (separate) data for forward and reverse calculations.
Expected results:	Results should agree to within 0.001" of the test data. See file *GIGS_tfm_52xx_output_[version_date].xls*, worksheet 5207 NTv2. For the round trip calculation the initial coordinates of the point should change by less than 0.0002" after 1000 iterations. Test result will be pass or fail. If fail, details of failure should be recorded.
Issues:	• This method uses longitudes positive to the west. This should be handled internally within the geoscience software, as the EPSG and ISO convention of longitudes positive east should be presented to users. • In North America there is overlap of NADCON and NTv2 grid coverage. For geoscience software including both methods the results in the area of overlap should be checked. Some of the test points are in these overlap areas and common with those in test procedure 5206. See figure 1 above. Results should be compared. The expectation is that NADCON grids are used within the USA and NTv2 grids are used within Canada. • Some geoscience software supports this method only for Canada. However, the NTv2 transformation method is actively used in many countries outside of Canada (where it originated). For example, official NTv2 coordinate transformations exist for Australia, New Zealand, France, Spain and Germany. • A problem has been reported with the implementation of NTv2 grids in Australia in some software. The problem points appear to fall on certain parallels and meridians, such as 8.55°S and 138.05°E, which match edge points or corner points of the Australian NTv2 subgrids. Points to test the 138.05°E meridian have been included. However the parallel of 8.55°S fell outside the Australian online converter used for generating the test dataset. The included task should suffice since failure at the selected meridian 138.05°E test points (or lack thereof) will indicate failure at the other problematic subgrid junction points too.

Test procedure:	**GIGS 5208. Longitude rotation.**
Test purpose:	To verify that transformations for the Longitude Rotation method are consistent with EPSG method 9601.
Test method:	Invoke coordinate transformation and inspect results.
Test data:	*GIGS_tfm_5208_LonRot_input_[version_date].xls.* This file includes (separate) data for forward and reverse calculations.
Expected results:	Results should agree to within 0.001" of the test data. See file *GIGS_tfm_52xx_output_[version_date].xls*, worksheet 5208 LonRot. For the round trip calculation the initial coordinates of the point should change by less than 0.0002" after 1000 iterations. Test result will be pass or fail. If fail, details of failure should be recorded.
Issues:	Geoscience software may not handle CRSs using a prime meridian other than (by default) Greenwich. This should be considered a failure for this method.

Test procedure:	**GIGS 5209. P6 seismic bin grid transformation.**
Test purpose:	To verify that transformations for the P6 seismic bin grid affine method are consistent with EPSG method 9666
Test method:	Invoke coordinate operation and inspect results.
Test data:	*GIGS_conv_5209_P6_input_[version_date].xls.* This file includes (separate) data for forward and reverse calculations.
Expected results:	Results should agree to within 0.03m of the test data. See file *GIGS_tfm_52xx_output_[version_date].xls*, worksheet 5209 P6. For the round trip calculation the initial coordinates of the point should change by less than 6mm after 1000 iterations. Test result will be pass or fail. If fail, details of failure should be recorded.
Issues:	If the geoscience software does not handle P6 bin grid data, this test procedure should be documented as non-applicable.

Test procedure:	**GIGS 5210. Vertical offset.**
Test purpose:	To verify that transformations for the vertical offset method are consistent with EPSG method 9616.
Test method:	Invoke coordinate transformation and inspect results.
Test data:	*GIGS_tfm_5210_VertOff_input_[version_date].xls.* This file includes (separate) data for forward and reverse calculations using GIGS vertical datums V and W, that is, vertCRSs V1 height, V1 depth, W1 height and W1 depth.
Expected results:	Results should agree to within 0.01m of the test data. See file *GIGS_tfm_52xx_ output_[version_date].xls*, worksheet 5210 VertOff. For the round trip calculation the initial coordinates of the point should change by less than 6mm after 1000 iterations. Test result will be pass or fail. If fail, details of failure should be recorded.
Issues:	Geoscience software may not handle both heights and depths simultaneously with correct signage.

Test procedure:	**GIGS 5211. Geocentric translations (geocentric domain) transformations**
Test purpose:	To verify whether coordinate transformations for the geocentric translation method which operate from and to geocentric Cartesian coordinates are consistent with EPSG transformation method 1031.
Test method:	Invoke coordinate transformation and inspect results.
Test data:	*GIGS_tfm_5211_ 3translation_Geocen_input_[version_date].xls.* This file includes (separate) data for forward and reverse calculations.
Expected results:	Results should agree to within 0.001m of the test data. See file *GIGS_tfm_52xx output_[version_date].xls*, worksheet 5211 3trnslt_geocen. For the round trip calculation the initial coordinates of the point should change by less than 6mm after 1000 iterations. Test result will be pass or fail. If fail, details of failure should be recorded.
Issues:	• Geoscience software may not handle geocentric Cartesian coordinates. Should this be the case, then this test cannot be conducted. The reason for failure should be stated. • See test procedures GIGS 5212 and 5213 for similar tests operating between geographic 2D CRSs and geographic 3D CRSs respectively. • The same test point input coordinates are used as input in test procedures GIGS 5201, 5203-5205 and 5211-5213.

Test procedure:	**GIGS 5212. Geocentric translations (geographic 3D domain) transformations.**
Test purpose:	To verify whether coordinate transformations for the Geocentric Translation method which operate from and to geographic 3D coordinate reference systems are consistent with EPSG method 1035.
Test method:	Invoke coordinate transformation and inspect results.
Test data:	*GIGS_tfm_5212_Geocen_geocen_input_[version_date].xls*. This file includes (separate) data for forward and reverse calculations.
Expected results:	Results should agree to within 0.001″ horizontal and 0.01m vertical of the test data. See file *GIGS_tfm_52xx _output_[version_date].xls*, worksheet 5212 3trnslt_geog3D. For the round trip calculation the initial coordinates of the point should change by less than 0.0002″ horizontal and 6mm vertical after 1000 iterations. Test result will be pass or fail. If fail, details of failure should be recorded. Some geoscience software ignores the ellipsoidal heights during these transformations (or set the input ellipsoidal heights to zero). If that is the case, horizontal coordinates obtained for those points with ellipsoidal heights significantly different from zero will be incorrect, whereas correct results may be generated for points with zero (or near zero) ellipsoidal heights. For large ellipsoidal heights (either positive or negative), the correct results are given by the geog3D EPSG method 1035. Which results are matched should be clearly documented in the report on the test results. (The results file includes data generated using the Abridged Molodensky method to assist this evaluation).
Issues:	• See test procedures GIGS 5211 and 5213 for similar tests operating between geocentric CRSs and geographic 2D CRSs respectively. • The same test point input coordinates are used as input in test procedures GIGS 5201, 5203-5205 and 5211-5213. In general output coordinates differ due to the different CRSs and transformations in these tests. However the intermediate geocentric coordinates obtained performing this method are used as both input and output coordinates for test procedure GIGS 5211 above.

Test procedure:	**GIGS 5213. Geocentric translations (geographic 2D domain) transformations.**
Test purpose:	To verify whether coordinate transformations for the geocentric translation method which operate from and to geographic 2D coordinate reference systems are consistent with EPSG methods. [Either EPSG the geocentric translation (geog2D domain), method 9603 or Abridged Molodensky method 9605 is acceptable.].
Test method:	Invoke coordinate transformation and inspect results.
Test data:	*GIGS_tfm_5213_3translation_Geog2D_input_[version_date].xls*. This file includes (separate) data for forward and reverse calculations.
Expected results:	One of two possible sets of results should agree to within 0.001″ of the test data. See file *GIGS_tfm_52xx_ output_[version_date].xls*, worksheet 5213 3trnslt_geog2D. These two sets use alternative methods, both of which are valid for the transformation of geographic 2D CRSs. Report which of the coordinate transformation methods the software is using. For the round trip calculation the initial coordinates of the point should change by less than 0.0002″ after 1000 iterations. Test result will be pass or fail. If fail, details of failure should be recorded.
Issues:	• See test procedures GIGS 5211 and 5213 for similar tests operating between geocentric CRSs and geographic 3D CRSs respectively. • This test uses a subset of the points used as input into test procedures GIGS 5201, 5203-5205 and 5212.

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4 – Test data and procedures – seismic location data

The tests for seismic location data in Series 5300 (2D seismic) and Series 5400 (3D seismic) require loading and unloading of test data to a geoscience software 'project'. For these tests, projects are required to be referenced to specific coordinate reference systems as defined in the test procedures below. See Appendix 4 for an explanation of the project naming and see the user-defined library Series 3000 for the definitions of these CRSs. The projects are also used for the Series 5500 well tests.

The majority of tests use a project area in the southwestern part of the North Sea. This area was chosen because it is within extended reach of surrounding countries in which CRSs using several important projection and transformation methods are found. However, to protect the test data from working satisfactorily in geoscience software with fixed parameters which happen to be applicable to the project area, a fictitious CRS (WGS 84 / British National Grid) was chosen as the target for data. To test geodetic data from elsewhere in the world, other fictitious systems such as one using US Survey Feet were applied to this setting.

4.1 Series 5300 – 2D seismic location data handling

The tests in this section use hypothetical seismic line location data. The test dataset files for these tests are synthetic UKOOA P1/90 format text files (file extension .P1), for which an equivalent comma separated variable (.csv) file is also provided for geoscience software that cannot handle P1/90. For each test the coordinates expected after the data have been manipulated per test instructions are given in an output file in MS Excel (.xls) format. This section also includes tests to examine the ability of the geoscience software to handle other industry data exchange formats.

The seismic 2D location data have been designed so that if converted or transformed correctly the seismic lines will intersect.

The GIGS Test Dataset (currently) provides only UKOOA P1/90 format, but reviewers may wish to repeat the following test procedures using other 2D seismic location data exchange formats they consider important.

Test procedure:	**GIGS 5306. Import 2D seismic location data with projection change (1).**
Test purpose:	To verify that the geoscience software correctly loads horizontal locations from a UKOOA P1/90 format file with traditional "full definition" CRS definition records when a change of map projection is involved.
Test method:	1. Load data from test input file to project *GIGS_project_A2V1depth*. 2. Verify coordinates in project *GIGS_project_A2V1depth* against expected results.
Test data:	*GIGS_seis2D_5306_input_[version_date].P1.* There are two P1/90 files within the test input file, one for onshore, the other for offshore. The onshore data includes height rather than depth.
Expected results:	• The geoscience software recognises P1/90 file CRS definition, converts P1/90 file horizontal coordinates and stores correct horizontal locations. See file *GIGS_seis2D_5306-5315_output_[version_date].xls.* • The geoscience software stores audit of CRS actions. See test GIGS 6001.
Issues:	• This test involves a change of horizontal CRS from input CRS defined in the input file to project CRS. The test output file assumes that the geoscience software applies a coordinate change and then stores coordinates in the CRS to which the project is referenced. • The software should retain an audit trail of coordinate change actions. See Series 6000 tests. • The P1/90 file format requires both geographic and grid coordinates. To verify that the software is handling grid coordinates, the geographic coordinates in the test file have been set to zero and therefore if used by the loader should cause the seismic location data to appear outside of the project area. • The input file part 1 includes vertical coordinates referenced to a different vertical CRS to that of the project. This is evaluated in test procedure GIGS 5314. • The same input data is used for Series 6000 audit trail tests. • If the software cannot import P-format data but has a generic ASCII loader, report this and use the equivalent data in file *GIGS_seis2D_5306_input_[version_date].csv.*

Test procedure:	**GIGS 5307. Import 2D seismic location data with projection change (2).**
Test purpose:	To verify that the geoscience software correctly loads horizontal locations from a UKOOA P1/90 format file with EPSG CRS identification when a change of map projection is involved.
Test method:	1. Load data from test input file to project *GIGS_project_A2V1depth*. 2. Verify coordinates in project *GIGS_project_A2V1depth* against expected results.
Test data:	*GIGS_seis2D_5307_input_[version_date].P1.*
Expected results:	The geoscience software recognises P1/90 file CRS definition, converts P1/90 file horizontal coordinates and stores correct horizontal locations. See file *GIGS_seis2D_5306-5315_output_[version_date].xls.*
Issues:	• See test procedure GIGS 5306. • The same input data is used for Series 6000 audit trail tests. • If the software cannot import P-format data but has a generic ASCII loader, report this and use the equivalent data in file *GIGS_seis2D_5307_input_[version_date].csv.*

Test procedure:	**GIGS 5308. Import 2D seismic location data with geodetic datum change (1).**
Test purpose:	To verify that the geoscience software correctly loads horizontal locations from a UKOOA P1/90 format file with traditional CRS definition records when a change of geodetic datum is involved.
Test method:	1. Load data from test input file to project *GIGS_project_A2V1depth*. 2. Verify coordinates in project *GIGS_project_A2V1depth* against expected results.
Test data:	*GIGS_seis2D_5308_input_[version_date].P1.* There are two P1 files within the test input file, one for onshore, the other for offshore.
Expected results:	The geoscience software recognises P1/90 file CRS definition, converts P1/90 file horizontal coordinates and stores correct horizontal locations. See file *GIGS_seis2D_5306-15_output_[version_date].xls.*
Issues:	• This test involves a change of horizontal CRS from input CRS to project CRS. The test output file assumes that the software applies a coordinate transformation and then stores coordinates in the CRS to which the project is referenced. • The geoscience software should retain an audit trail of coordinate change actions. See Series 6000 tests. • The P1 file format requires both geographic and grid coordinates. To verify that the software is handling geographic coordinates, the grid coordinates in the test file have been set to zero and therefore if used by the loader should cause the seismic location data to appear outside the project area. • If the software cannot import P-format data but has a generic ASCII loader, report this and use the equivalent data in file *GIGS_seis2D_5308_input_[version_date].csv.*

Test procedure:	**GIGS 5309. Import 2D seismic location data with geodetic datum change (2).**
Test purpose:	To verify that the geoscience software correctly loads horizontal locations from a UKOOA P1/90 format file with EPSG CRS identification when a change of geodetic datum is involved.
Test method:	1. Load data from test input file to project *GIGS_project_A2V1depth*. 2. Verify coordinates in project *GIGS_project_A2V1depth* against expected results.
Test data:	*GIGS_seis2D_5309_input_[version_date].P1.*
Expected results:	The geoscience software recognises P1/90 file CRS definition, converts P1/90 file horizontal coordinates and stores correct horizontal locations. See file *GIGS_seis2D_5306-5315_output_[version_date].xls.*
Issues:	See test 5308.

Test procedure:	**GIGS 5310. Import 2D seismic location data with change of horizontal units.**
Test purpose:	To verify that the geoscience software correctly loads horizontal locations from a UKOOA P1/90 format file when a change in projected CRS coordinate units (m/ft) is applied.
Test method:	1. Load data from test input file to project *GIGS_project_A2V1depth*. 2. Verify coordinates in project *GIGS_project_A2V1depth* against expected results.
Test data:	*GIGS_seis2D_5310_input_[version_date].P1.*
Expected results:	The geoscience software recognises P1/90 file CRS definition, converts P1/90 file horizontal coordinates and stores correct horizontal locations. The vertical CRS units should not be converted. See file *GIGS_seis2D_5306-5315_output_[version_date].xls.*
Issues:	• The P1/90 file format requires both geographic and grid coordinates. To verify that the software is handling grid coordinates, the geographic coordinates in the test file have been set to zero and therefore if used by the loader should cause the seismic location data to appear outside the project area. • If the software cannot import P-format data but has a generic ASCII loader, report this and use the equivalent data in file *GIGS_seis2D_5310_input_[version_date].csv.*

Test procedure:	**GIGS 5311. Import 2D seismic location data with coordinates in grads.**
Test purpose:	To verify that the geoscience software correctly loads coordinates given in grads.
Test method:	1. Load data from test input file to project *GIGS_project_A2V1depth*. 2. Verify coordinates in project *GIGS_project_A2V1depth* against expected results.
Test data:	*GIGS_seis2D_5311_input_[version_date].P1.*
Expected results:	The geoscience software recognises P1/90 file CRS definition, converts P1/90 file horizontal coordinates in grads and stores correct horizontal locations. See file *GIGS_seis2D_5306-5315_output_[version_date].xls.*
Issues:	• The P1/90 file format requires both geographic and grid coordinates. To verify that the software is handling grid coordinates, the geographic coordinates in the test file have been set to zero and therefore if used by the loader should cause the seismic location data to appear outside the project area. • If the software cannot import P-format data but has a generic ASCII loader, report this and use the equivalent data in file *GIGS_seis2D_5311_input_[version_date].csv.*

Test procedure:	**GIGS 5312. Import 2D seismic location data with vertical datum change.**
Test purpose:	To verify that the geoscience software correctly loads vertical locations from a UKOOA P1/90 format file when a change of vertical datum is involved.
Test method:	1. Load data from test input file to project *GIGS_project_A2V1depth*. 2. Verify coordinates in project *GIGS_project_A2V1depth* against expected results.
Test data:	*GIGS_seis2D_5312_input_[version_date].P1.* There are two P1 files within the test input file, one for onshore data with heights, and the other for offshore data with depths.
Expected results:	The geoscience software recognises P1/90 file CRS definition, transforms P1/90 file vertical coordinates and stores correct vertical locations. See file *GIGS_seis2D_5306-5315_output_[version_date].xls.*
Issues:	• This test involves a change of CRS from input CRS to project CRS. The test output file assumes that the software applies a coordinate transformation and then stores coordinates in the CRS to which the project is referenced. • The software should retain an audit trail of coordinate change actions. See Series 6000 tests. • If the software cannot import P-format data but has a generic ASCII loader, report this and use the equivalent data in file *GIGS_seis2D_5312_input_[version_date].csv.*

Test procedure:	**GIGS 5313. Import 2D location seismic data with ellipsoidal height.**
Test purpose:	To verify that the geoscience software correctly loads vertical locations when ellipsoidal height is used.
Test method:	1. Load data from test input file to project *GIGS_project_A2V1depth*. 2. Verify coordinates in project *GIGS_project_A2V1depth* against expected results.
Test data:	*GIGS_seis2D_5313_input_[version_date].P1.*
Expected results:	The geoscience software recognises P1/90 file CRS definition, transforms P1/90 file ellipsoidal 3D coordinates and stores correct vertical locations. See file *GIGS_seis2D 5306-5315_output_[version_date].xls.*
Issues:	• This test involves a change from ellipsoidal height given in the input file to the gravity-related height system which the project uses. The test assumes that the software applies a geoid model coordinate transformation and then stores coordinates in the CRS to which the project is referenced. The EGM96 geoid model is assumed. • The P1/90 file format requires both geographic and grid coordinates. To verify that the software is handling geographic 3D coordinates, the grid coordinates in the test file have been set to zero and therefore if used by the loader should cause the seismic location data to appear outside the project area. • The software should retain an audit trail of coordinate change actions. See Series 6000 tests. • If the software cannot import P-format data but has a generic ASCII loader, report this and use the equivalent data in file *GIGS_seis2D_5313_input_[version_date].csv.*

Test procedure:	**GIGS 5314. Import 2D location seismic data with change of vertical units.**
Test purpose:	To verify that the geoscience software correctly loads vertical locations from a UKOOA P1/90 format file when a change in vertical coordinate units (ft/m) is applied.
Test method:	1. Load data from test input file to project *GIGS_project_A2V1depth*. 2. Verify coordinates in project *GIGS_project_A2V1depth* against expected results.
Test data:	*GIGS_seis2D_5314_input_[version_date].P1.*
Expected results:	The geoscience software recognises P1/90 file CRS definition, converts P1/90 file vertical coordinates and stores correct vertical values. See file *GIGS_seis2D_5306-5315_output_[version_date].xls.*
Issues:	If the software cannot import P-format data but has a generic ASCII loader, report this and use the equivalent data in file *GIGS_seis2D_5314_input_[version_date].csv.*

Test procedure:	**GIGS 5315. Import and decimate or reduce 2D seismic location data.**
Test purpose:	To verify that the geoscience software correctly loads and "decimates" locations from a UKOOA P1/90 format file. The test is designed to reduce the number of locations stored to the minimum required to honour line geometry, that is to store only line end points and, if present, intermediate points at which the line orientation changes (bends). The test is in the horizontal domain only. Sometimes called "decimation" because some geoscience software stores every tenth location. No coordinate conversions or transformations are required for this test.
Test method:	1. Load data from test input file to project *GIGS_project_A2V1depth.* 2. Verify coordinates in project *GIGS_project_A2V1depth* against expected results.
Test data:	*GIGS_seis2D_5315_input_[version_date].P1.*
Expected results:	The geoscience software stores correct horizontal locations. See file *GIGS_5306-5315_seis2D_output_[version_date].xls.*
Issues:	• Line GIGS-5315-16 includes two curves: geoscience software may vary in how it treats these. The output file includes every shotpoint around these curves. • Line GIGS-5315-17 has a location (shotpoint 302) having anomalous input coordinates. It should be filtered out. • If the software cannot import P-format data but has a generic ASCII loader, report this and use the equivalent data in file *GIGS_seis2D_5315_input_[version_date].csv.*

Test procedure:	**GIGS 5316. Export 2D seismic location data with projection change.**
Test purpose:	To verify that the geoscience software correctly exports to a UKOOA P1/90 format file when a change of map projection is involved but when the same base geographic CRS is maintained.
Test method:	1. Export the test data from project GIGS_project_A2V1depth, the exported data to be in UKOOA P1/90 format referenced horizontally to CRS GIGS projCRS A1 (WGS 84/UTM zone 31N, EPSG CRS code 32631). 2. Verify coordinates in the exported data file against expected results.
Test data:	Seismic line GIGS-5315-17 from *GIGS_project_A2V1depth*.
Expected results:	• The geoscience software exports locations correctly. Pass/fail. • The geoscience software exports CRS definition correctly. Pass/fail. See file *GIGS_seis2D_5316_output_[version_date].P1*. (File *GIGS_seis2D_5320-5316_output_[version_date].xls* also contains the same data).
Issues:	• This test assumes that seismic line GIGS-5315-17 has been correctly loaded to the project (see test procedure GIGS 5315). • The same test data is used for test procedures GIGS 5316, 5319, 5320 and 5323. Output for GIGS 5316 and GIGS 5320 should have same coordinate values, only the medium differs.

Test procedure:	**GIGS 5317. Export 2D seismic location data with geodetic datum change.**
Test purpose:	To verify that the geoscience software correctly exports to a UKOOA P1/90 format file when a change of geodetic datum is involved.
Test method:	1. Export the test data from project *GIGS_project_A2V1depth*, the exported data to be in UKOOA P1/90 format referenced horizontally to CRS GIGS projCRS B2 (OSGB 1936/British National Grid, EPSG CRS code 27700. 2. Verify coordinates in exported data file against expected results.
Test data:	Seismic lines GIGS-5306-05 and GIGS-5306-11 from project *GIGS_project_A2V1depth*.
Expected results:	• The geoscience software exports locations correctly. Pass/fail. • The geoscience software exports CRS definition correctly. Pass/fail. See file *GIGS_seis2D_5317_output_[version_date].P1* (File *GIGS_seis2D_5321-5317_output_[version_date].xls* also contains the same data).
Issues:	• This test assumes that seismic lines GIGS-5306-05 and GIGS-5306-11 have been correctly loaded to the project (see test procedure GIGS 5306). • The same input test data is used for test procedures GIGS 5317 and GIGS 5321. Output should have same coordinate values, only the medium differs.

Test procedure:	**GIGS 5318. Export 2D seismic location data with change of horizontal units.**
Test purpose:	To verify that the geoscience software correctly exports to a UKOOA P1/90 format file when a change of horizontal CRS unit (m/ft) is involved.
Test method:	1. Export the test data from project *GIGS_project_A2V1depth*, the exported data to be in UKOOA P1/90 format referenced horizontally to CRS GIGS projCRS A23 (WGS 84/BLM 31N (ftUS)). 2. Verify coordinates in exported data file against expected results.
Test data:	Seismic lines GIGS-5306-05 and GIGS-5306-11 from project *GIGS_project_A2V1depth*.
Expected results:	• The geoscience software exports locations correctly. Pass/fail. • The geoscience software exports CRS definition correctly. Pass/fail. See file *GIGS_seis2D_5317_output_[version_date].P1* (File *GIGS_seis2D_5321-5317_output_[version_date].xls* also contains the same data).
Issues:	• This test assumes that seismic lines GIGS-5306-05 and GIGS-5306-11 have been correctly loaded to the project (see test procedure GIGS 5306). • The same input test data is used for test procedures GIGS 5317 and GIGS 5321. Output should have same coordinate values, only the medium differs.

Test procedure:	**GIGS 5319. Export 2D seismic location data with vertical datum change.**
Test purpose:	To verify that the geoscience software correctly exports to a UKOOA P1/90 format file when a change of vertical datum is involved.
Test method:	1. Export the test data from project *GIGS_project_A2V1depth*, the exported data to be in UKOOA P1/90 format referenced vertically to CRS GIGS vertCRS W1 depth (Caspian depth, EPSG CRS code 5706). 2. Verify coordinates in exported data file against expected results.
Test data:	Seismic line GIGS-5315-17 from project *GIGS_project_A2V1depth*.
Expected results:	• The geoscience software exports locations correctly. Pass/fail. • The geoscience software exports CRS definition correctly. Pass/fail. See file *GIGS_seis2D_5319_output_[version_date].P1* (File *GIGS_seis2D_5323-19_output_[version_date].xls* also contains the same data).
Issues:	• This test assumes that seismic line GIGS-5315-17 has been correctly loaded to the project (see test procedure GIGS 5315). • The same input test data is used for test procedures GIGS 5316, 5319, 5320 and 5323. Output for GIGS 5319 and GIGS 5323 should have same coordinate values, only the medium differs.

Test procedure:	**GIGS 5320. Transfer 2D seismic location data with projection change.**
Test purpose:	To verify that the geoscience software correctly transfers 2D seismic location data to a different project when a change of map projection is required.
Test method:	1. In project *GIGS_project_A2V1depth*, select test data described below. 2. Transfer to project *GIGS_project_A1W_A1W1depth*. 3. Verify data in project *GIGS_project_A1W_A1W1depth* against expected results.
Test data:	Seismic line GIGS-5315-17 from project *GIGS_project_A2V1depth*.
Expected results:	The geoscience software transfers horizontal and vertical locations correctly. See file *GIGS_seis2D_5320-5316_output_[version_date].xls*. Pass/fail.
Issues:	• This test involves a change of CRS from source project CRS to target project CRS. The test assumes that the software applies a coordinate change and then stores coordinates in the CRS to which the target project is referenced. • The test assumes that seismic line GIGS-5315-17 has been correctly loaded to the source project (see test procedure GIGS 5315). • The same input test data is used for test procedures GIGS 5316, 5319, 5320 and 5323. Output for GIGS 5316 and GIGS 5320 should have same coordinate values, only the medium differs. • The software should retain an audit trail of coordinate change actions. See Series 6000 tests.

Test procedure:	**GIGS 5321. Transfer 2D seismic location data with geodetic datum change.**
Test purpose:	To verify that the geoscience software correctly transfers 2D seismic location data to a different project when a change of geodetic datum is required.
Test method:	1. In project *GIGS_project_A2V1depth*, select test data described below. 2. Transfer to project *GIGS_project_B2V1depth*. 3. Verify data in project *GIGS_project_B2V1depth* against expected results.
Test data:	Seismic lines GIGS-5306-05 and GIGS-5306-11 from project *GIGS_project_A2V1depth*.
Expected results:	The geoscience software transfers horizontal locations correctly. See file *GIGS_seis2D_5321-5317_output_[version_date].xls*. Pass/fail.
Issues:	• This test involves a change of CRS from source project CRS to target project CRS. The test assumes that the software applies a coordinate change and then stores coordinates in the CRS to which the target project is referenced. • The test assumes that seismic lines GIGS-5306-05 and GIGS-5306-11 have been correctly loaded to the source project (see test procedure GIGS 5306). • The same input test data is used for test procedures GIGS 5317 and GIGS 5321. Output should have same coordinate values, only the medium differs. • The geoscience software should retain an audit trail of coordinate change actions. See Series 6000 tests.

Test procedure:	**GIGS 5322. Transfer 2D seismic location data with horizontal unit change.**
Test purpose:	To verify that the geoscience software correctly transfers 2D seismic location data to a different project when a change of horizontal CRS unit (m/ft) is required.
Test method:	1. In project *GIGS_project_A2V1depth*, select test data as described below. 2. Transfer to project *GIGS_project_A23V1depth*. 3. Verify data in project *GIGS_project_A23V1depth* against test data.
Test data:	Seismic lines GIGS-5306-04 and GIGS-5306-12 from project *GIGS_project_A2V1depth*.
Expected results:	The geoscience software transfers locations correctly. See file *GIGS_seis2D_5322-5318_output_[version_date].xls*. Pass/fail.
Issues:	• This test involves a change of CRS from source project CRS to target project CRS. The test assumes that the software applies a coordinate change and then stores coordinates in the CRS to which the target project is referenced. • The test assumes that seismic lines GIGS-5308-04 and GIGS-5308-12 have been correctly loaded to the source project (see test procedure GIGS 5308).. • The same input test data is used for test procedures 5318 and 5322. Output should have same coordinate values, only the medium differs. • The geoscience software should retain an audit trail of coordinate change actions. See Series 6000 tests.

Test procedure:	**GIGS 5323. Transfer 2D seismic location data with vertical datum change.**
Test purpose:	To verify that the geoscience software correctly transfers 2D seismic location data to a different project when a change of vertical datum is involved.
Test method:	1. In project *GIGS_project_A2V1depth*, select test data described below. 2. Transfer to project *GIGS_project_A1W1depth*. 3. Verify data in project *GIGS_project_A1W1depth* against test data.
Test data:	Seismic line GIGS-5315-17 from project *GIGS_project_A2V1depth*.
Expected results:	The geoscience software transfers locations correctly. See file *GIGS_seis2D_5323-5319_output_[version_date].xls*. Pass/fail.
Issues:	• This test involves a change of CRS from source project CRS to target project CRS. The test assumes that the software applies a coordinate change and then stores coordinates in the CRS to which the target project is referenced. • The test assumes that seismic line GIGS-5315-17 has been correctly loaded to the source project (see test procedure GIGS 5315). • The same input test data is used for test procedures GIGS 5316, 5319, 5320 and 5323. Output for GIGS 5319 and GIGS 5323 should have same coordinate values, only the medium differs. • The geoscience software should retain an audit trail of coordinate change actions. See Series 6000 tests.

Test procedure:	**GIGS 5324. Import 2D seismic location data with NADCON transformation.**
Test purpose:	To verify that the geoscience software correctly loads horizontal locations from a UKOOA P1/90 format file when a transformation using the NADCON method has to be applied.
Test method:	1. Load data from test input file to project *GIGS_project_Z28V1depth*. 2. Verify coordinates in project *GIGS_project_Z28V1depth* against expected results.
Test data:	*GIGS_seis2D_5324_input_[version_date].P1*.
Expected results:	The geoscience software recognises P1/90 file CRS definition, converts P1/90 file horizontal coordinates using the NADCON method, and stores correct horizontal locations. See file *GIGS_seis2D_5324-5325_output_[version_date].xls*. The input data includes some points also used for test procedure 5325, with common input points having identical coordinates. After transformation the coordinates of output points will not be the same as those output for test procedure 5325.
Issues:	• It may be necessary to force the software to utilise the NADCON method. • In North America the NADCON grids for Conus and Alaska overlap with the NTv2 grid for Canada. Software should use NADCON for locations in the US and NTv2 for locations in Canada. The test data includes lines which cross the national boundary. See also test procedure 5325. Note: the GIGS test data is not an authority on international boundaries. In the test results the indication of which points fall inside and outside of US is indicative only.

Test procedure:	**GIGS 5325. Import 2D seismic location data with NTv2 transformation.**
Test purpose:	To verify that the geoscience software correctly loads horizontal locations from a UKOOA P1/90 format file when a transformation using the NTv2 method has to be applied.
Test method:	1. Load data from test input file to project *GIGS_project_Z28V1depth*. 2. Verify coordinates in project *GIGS_project_Z28V1depth* against expected results.
Test data:	*GIGS_seis2D_5325_input_[version_date].P1.*
Expected results:	The geoscience software recognises P1/90 file CRS definition, converts P1/90 file horizontal coordinates using the NTv2 method, and stores correct horizontal locations. See file *GIGS_seis2D_5324-5325_output_[version_date].xls.* The input data includes some points also used for test procedure GIGS 5324, with common input points having identical coordinates. After transformation the coordinates of output points will not be the same as those output for test procedure 5324.
Issues:	• It may be necessary to force the software to utilise the NTv2 method. • In North America the NADCON grids for Conus and Alaska overlap with the NTv2 grid for Canada. Software should use NADCON for locations in the US and NTv2 for locations in Canada. The test data includes lines which cross the national boundary. See also test procedure 5324. Note: the GIGS test data is not an authority on international boundaries. In the test results the indication of which points fall inside and outside of Canada is indicative only.

4.2 Series 5400 – 3D seismic location data handling

The tests in this section use hypothetical 3D seismic line location data referenced to a variety of coordinate reference systems. The test dataset files for these tests are synthetic UKOOA P1/90 and P6/98 format text files (file extensions .P1 and .P6 respectively), for which an equivalent comma separated variable (.csv) file is also provided for geoscience software that cannot handle the P6/98 format. For each test the coordinates expected after the data have been manipulated per test instructions are given in an MS Excel (.xls) file.

Five overlapping synthetic surveys are used. Surveys A, B and C fall over part of the extensive Survey D. Survey E is a small site survey around platform Y. These are shown schematically in Figure 2, along with the horizontal locations of the synthetic wells that will be examined in Series 5500 tests. The map grid is at 10km intervals.

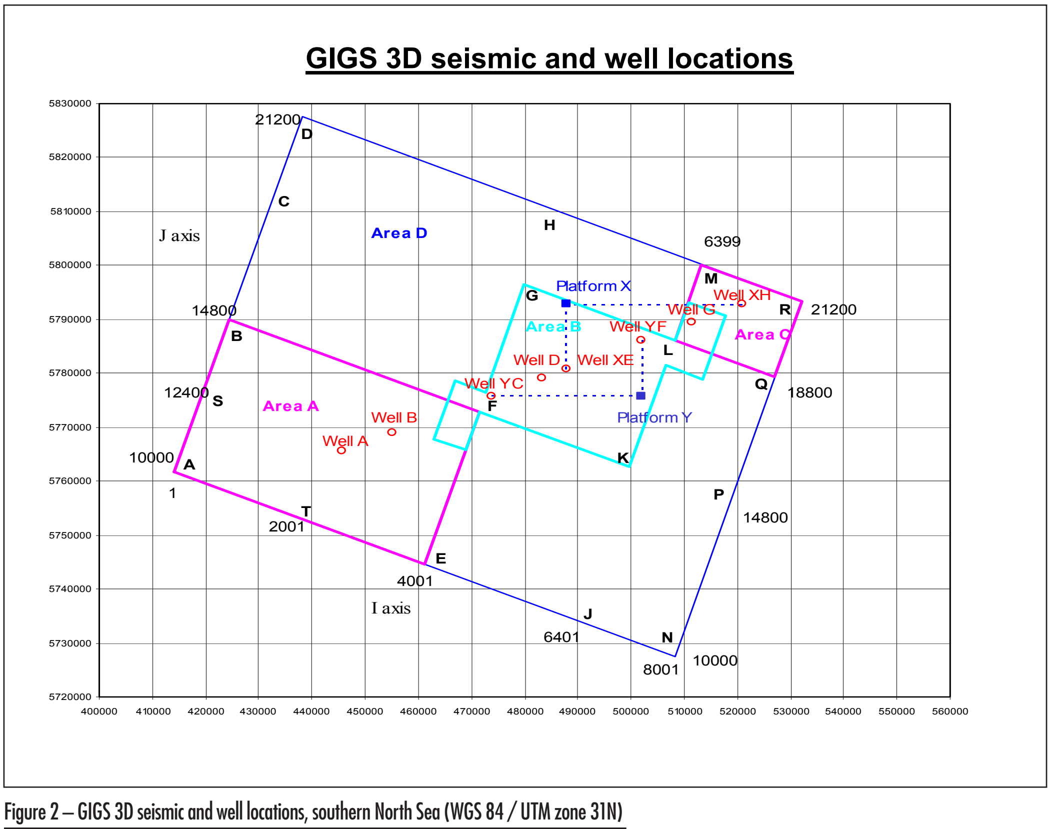

Figure 2 – GIGS 3D seismic and well locations, southern North Sea (WGS 84 / UTM zone 31N)

Test procedure:	**GIGS 5403. Import 3D seismic location data with CRS change.**
Test purpose:	To evaluate the position of 3D seismic location data when a change of coordinate reference system is required on import.
Test method:	1. Load test data to project *GIGS_project_A2V1depth*. 2. Measure coordinates of locations described in output data file. 3. Compare measured coordinates with output file coordinates. In particular document differences in the area of overlap between survey A and survey B and survey D (inline 3501 through 4001, crossline 13600 through 14800) and in the area of overlap between survey B and survey C and survey D (inline 6401 through 7001, crossline 18800 through 20000)
Test data:	*GIGS_seis3D_5403_input_surveyB_[version_date].P1* and also *either* (if the software can read P6/98 format file, see test 5401 documented in 430-2) *GIGS_seis3D_5403_input_surveyA_[version_date].P6,* *GIGS_seis3D_5403_input_surveyC_[version_date].P6; and* *GIGS_seis3D_5403_input_surveyD_[version_date].P6,* *or* (if the software cannot read P6/98 format file) *GIGS_seis3D_5403_input_surveysACD_not_P6_[version_date].xls*
Expected results:	*GIGS_seis3D_5403_output_[version_date].xls.*
Issues:	• The orthogonal properties of a seismic bin grid cannot be maintained if a change of coordinate reference system is introduced. The way that a seismic bin grid is defined within a project influences the effect of this phenomenon. • When reading coordinate values, care needs to be taken to ensure that it is the bin position rather than cursor position that is being measured. If software shows cursor position without notifying user, report this. • The input data is used for test procedures GIGS 5404 and 5405.

Test procedure:	**GIGS 5404. Export 3D seismic location data with CRS change.**
Test purpose:	To identify how the geoscience software exports 3D seismic location data when a change of CRS is involved.
Test method:	1. In *GIGS_project_A2V1depth*, select test data. 2. Export. 3. Describe results.
Test data:	See *GIGS_seis3D_5404-5_input_[version_date].txt.*
Expected results:	See *GIGS_seis3D_5404-5_output_[version_date].xls.*
Issues:	• The test assumes that the test data has been correctly loaded to the project. See test procedure GIGS 5403. • The same test data is used for test procedure GIGS 5405.

Test procedure:	**GIGS 5405. Transfer 3D seismic location data with CRS change.**
Test purpose:	To identify how the geoscience software transfers 3D seismic location data when a change of CRS is involved.
Test method:	1. In *GIGS_project_A2V1depth*, select test data. 2. Transfer to project *GIGS_project_A1W1depth*. 3. Describe results.
Test data:	See *GIGS_seis3D_5404-5_input_[version_date].txt.*
Expected results:	See *GIGS_seis3D_5404-5_output_[version_date].xls.*
Issues:	• The test assumes that the test data has been correctly loaded to the project. See test procedure 5403. • The same test data is used for test procedure GIGS 5404.

Test procedure:	**GIGS 5406. Import P6/98 extent and coverage data (without CRS change).**
Test purpose:	To identify that the geoscience software imports 3D coverage polygons based on bin grid extent, map grid extent, geographic extent, total coverage, full fold coverage, null full fold coverage island and null coverage island from P6/98 extent and coverage records.
Test method:	1. Load test data to project *GIGS_project_A2V1depth*. 2. Examine whether polygons for bin grid extent, map grid extent, geographic extent, total coverage, full fold coverage, null full fold coverage island and null coverage island are present. Coordinates should correspond to the input file.
Test data:	*GIGS_seis3D_5406-7_input_[version_date].P6*. See figure 3.
Expected results:	Extent rectangles and coverage polygons are present – see Figure 3. Coordinates should correspond to those in the input file (also given in file *GIGS_seis3D_5407_output_[version_date].xls*, see below).
Issues:	• If the software cannot read a P6/98 format file this test cannot be run. • The P6/98 format allows for extent records to be in bin grid and/or map grid and/or geographic coordinates. The test file provides all three. • The P6/98 format allows for coverage records to be in either bin grid and/or map grid coordinates. The test file provides both options. • The same test data is used for test procedure GIGS 5407.

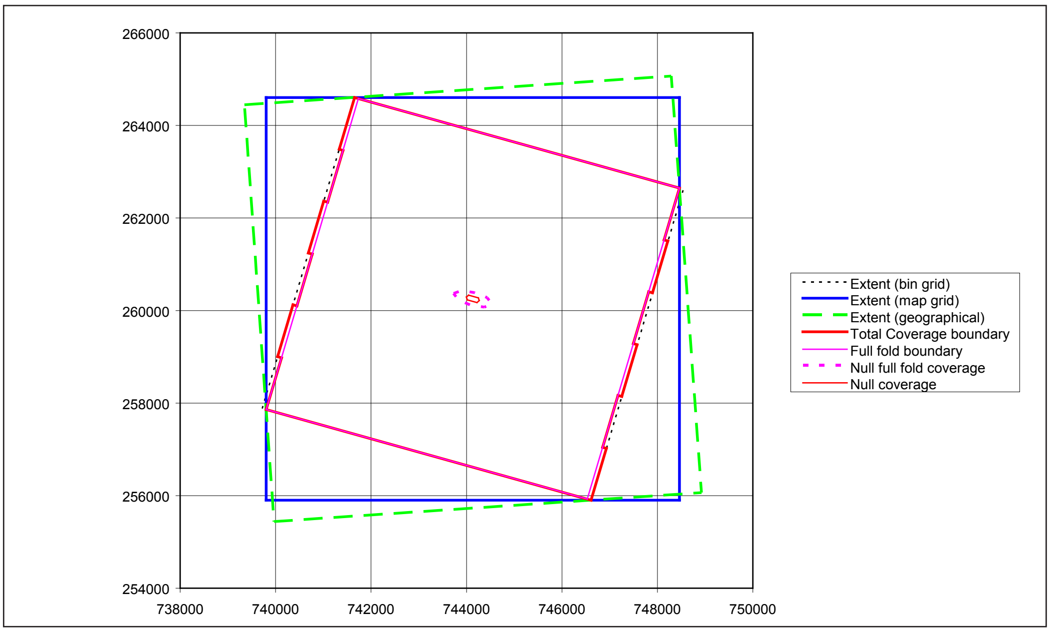

Figure 3 – GIGS 3D seismic survey E extent and coverage, southern North Sea (WGS 84 / British National Grid)

Test procedure:	**GIGS 5407. Import P6/98 extent data with CRS change.**
Test purpose:	To identify how the geoscience software imports different polygons based on bin grid extent, map grid extent, geographic extent, total coverage, full fold coverage, null full fold coverage island and null coverage island from P6/98 extent records when a change of CRS is involved.
Test method:	1. Load test data to project *GIGS_project_A1W1depth*. 2. Determine whether the coordinates of the polygon representing the survey extent match those of the test output file.
Test data:	*GIGS_seis3D_5406-7_input_[version_date].P6*.
Expected results:	*GIGS_seis3D_5407_output_[version_date].xls*.
Issues:	• If the software cannot read a P6/98 format file, this test cannot be run. • Extent map grid and geographic records are in the CRS to which the survey is referenced. If the data are loaded to a different CRS then the map grid and geographic bounding boxes need to be recalculated from the bin grid extent – a simple conversion of the map grid or geographic corner coordinates in the source CRS is not correct. • The three input files describe extent by one each of bin grid, map grid and geographic coordinates. In this test data set there is no datum change involved and the description of the geographic grid is not rigorously tested. • The same test data is used for test procedure 5406.

5 – Test data and procedures – series 5500 – surface and wellbore deviation data

The tests for wellbore data in Series 5500 require loading and unloading of test data to a geoscience software project. For these tests, projects are required to be referenced to specific coordinate reference systems as defined in the test procedures below. See Appendix 4 for an explanation of the project naming and see the user-defined library Series 3000 for the definitions of the CRSs used. The projects are also used for the Series 5300 and 5400 seismic location tests.

The majority of tests use a project area in the south-western part of the North Sea. This area was chosen because it is within extended reach of surrounding countries in which CRSs using several important projection and transformation methods are found. However, to protect the test data from working satisfactorily in geoscience software with fixed parameters which happen to be applicable to the project area, a fictitious CRS (WGS 84/British National Grid) was chosen as the target for data. To test geodetic data from elsewhere in the world, other fictitious systems such as one using US Survey Feet were applied to this setting.

The test procedures in this test series use hypothetical wellbore location data. The well surface positions given in the input files are referenced to a variety of horizontal and vertical CRSs. The test procedures require the wellbores to be loaded to a project. Test procedures 5506-5516 and 5526 examine whether these positions are correctly transformed to the horizontal and vertical CRSs to which the project is referenced. Eight wells A through H are used. Four (A, B, D and G) are vertical. The other four wells (C, E, F and H) are deviated wellbores from two hypothetical platforms X and Y.

The horizontal positions of the wells are shown schematically in Figure 2 in the previous section describing the GIGS 3D seismic location test procedures. The platform well general layouts and schematic cross sections are shown in the figures below.

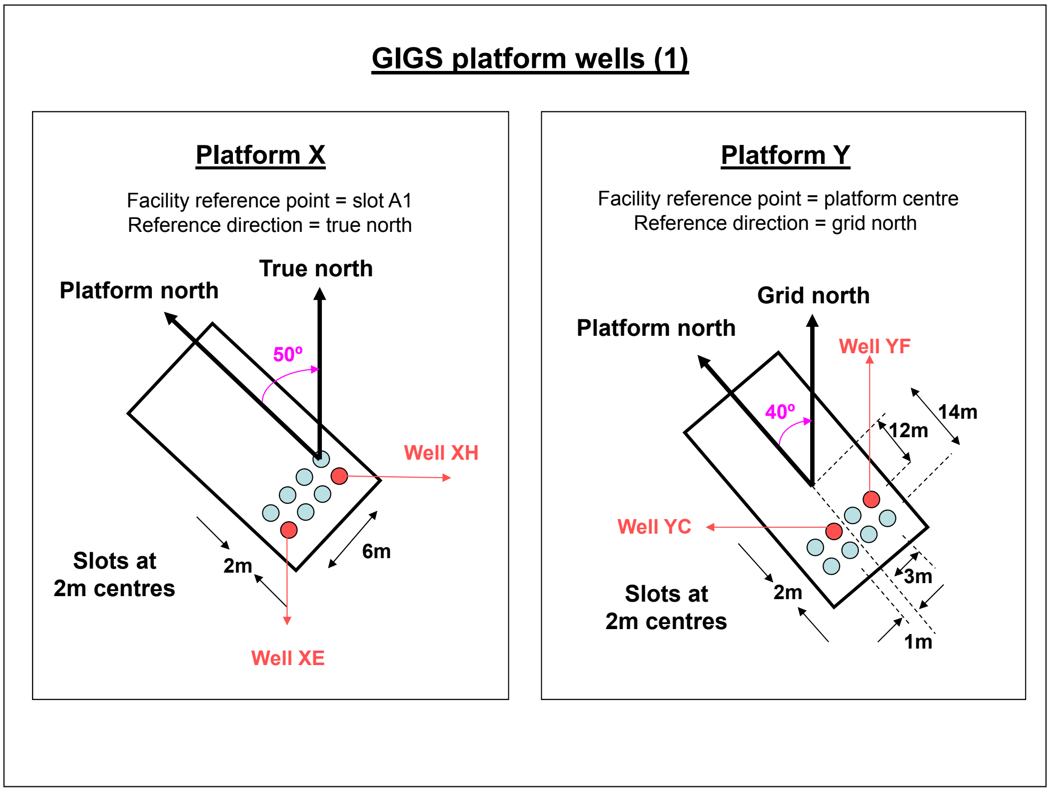

Figure 4 - Platform wells for northern hemisphere well tests

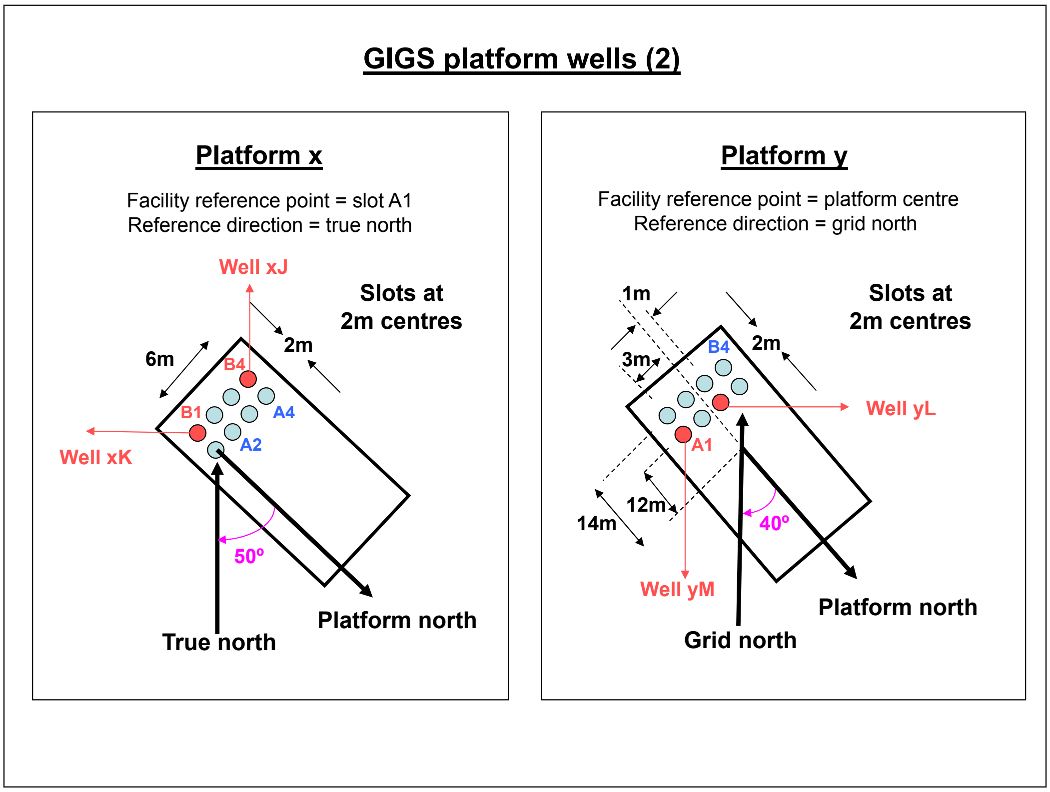

Figure 5 - Platform wells for southern hemisphere well tests

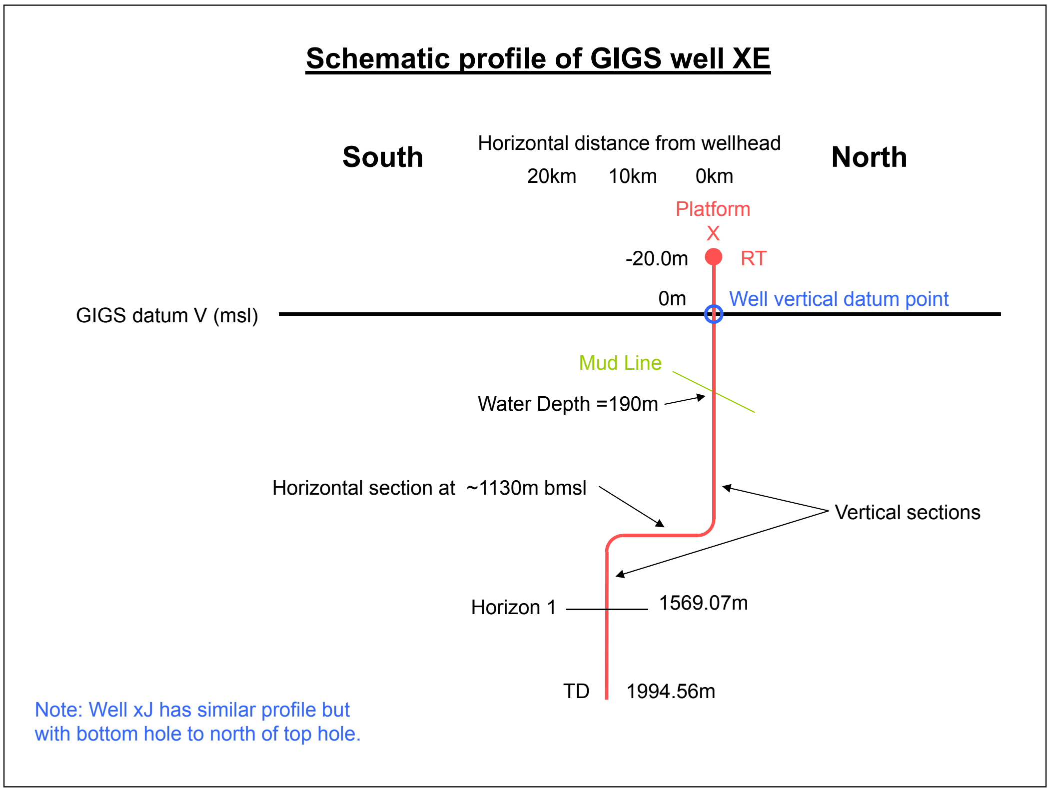

Figure 6 - Schematic profile of GIGS well XE

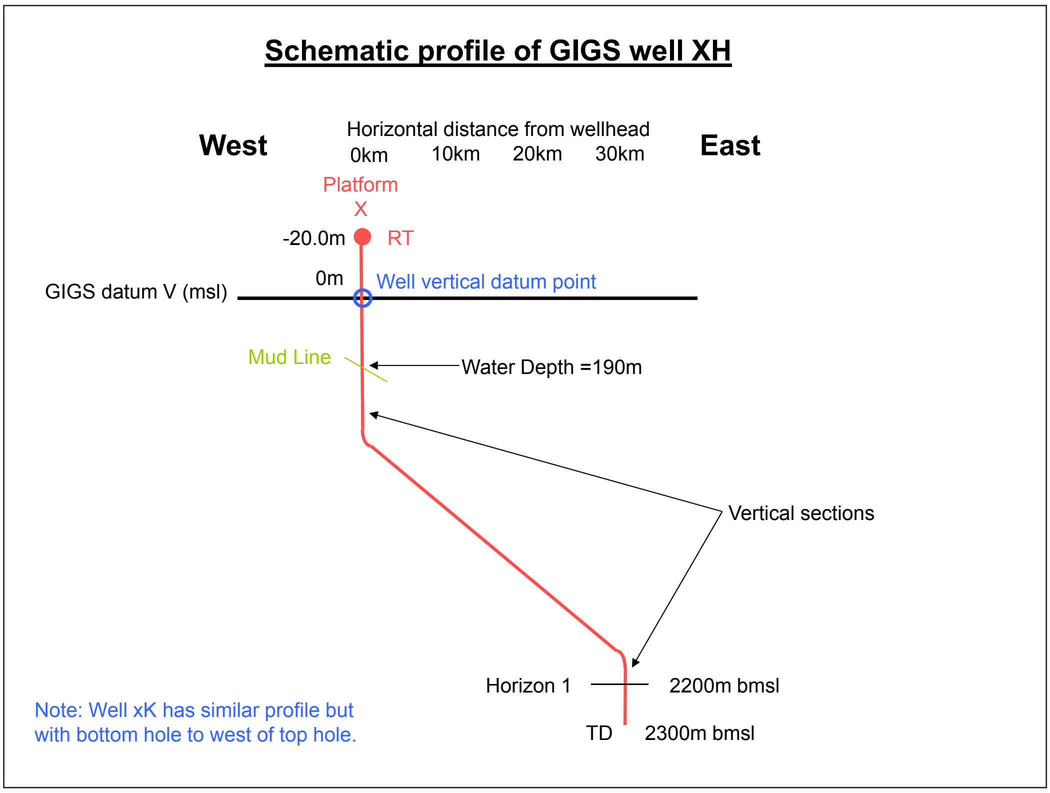

Figure 7 - Schematic profile of GIGS well XH

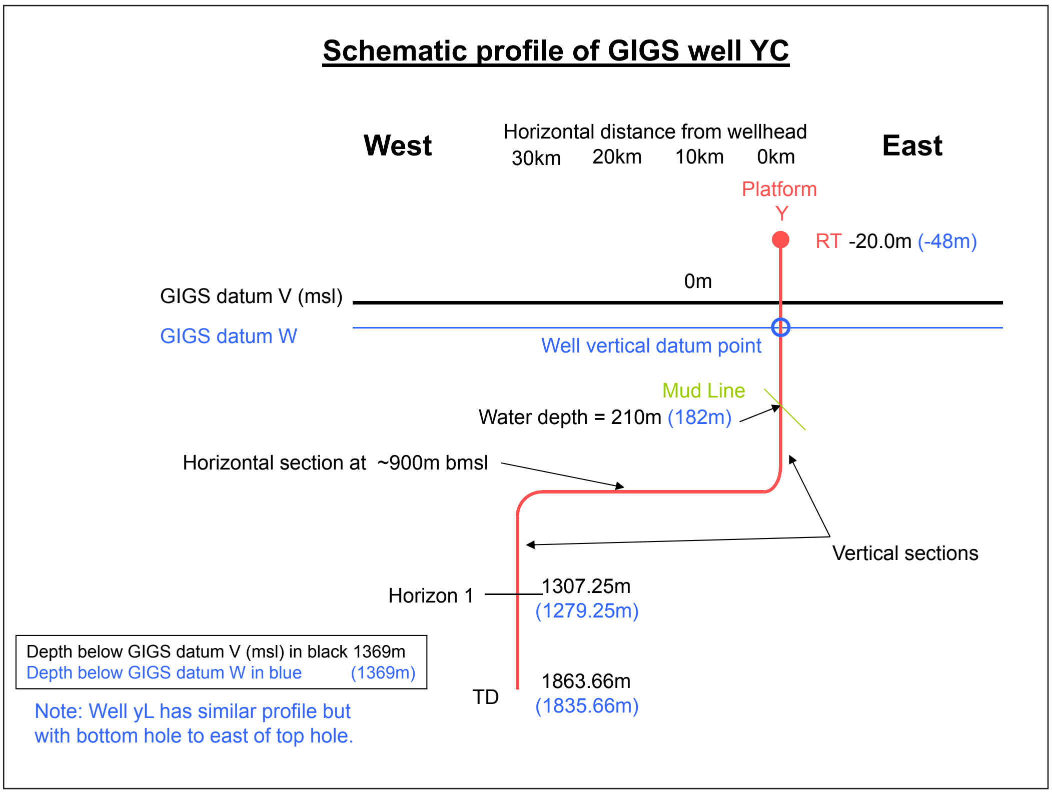

Figure 8 - Schematic profile of GIGS well YC

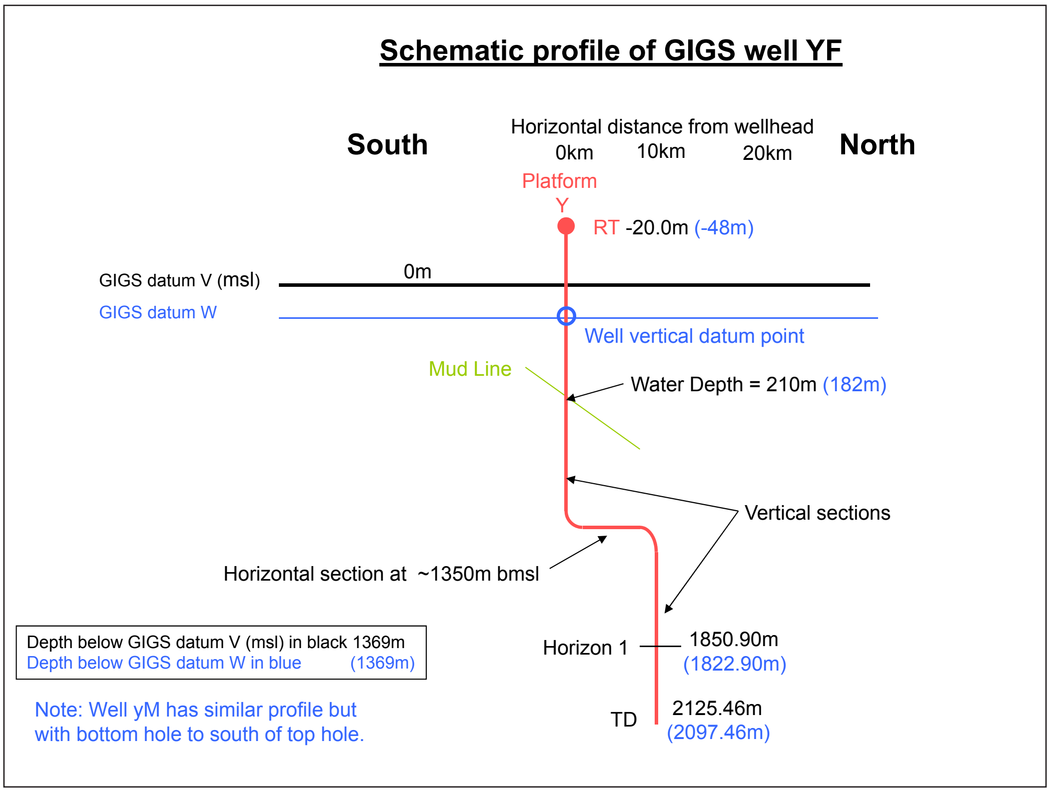

Figure 9 - Schematic profile of GIGS well YF

Each of the eight input well files is used in two tests (one testing horizontal geospatial integrity, the other testing vertical integrity):

Table 2 - GIGS well and platfirm ID for northern hemisphere tests

Well	Platform	Input to test procedures
A		5506, 5526
B		5507, 5517
C	Y	5511, 5515
D		5508, 5515
E	X	5510, 5514
F	Y	5511, 5515
G		5509, 5516
H	X	5510, 5514

Because the definition of the sign of grid convergence in the southern hemisphere has been the source of some confusion, the horizontal tests are repeated in an Australian setting using the four deviated wellbores recalculated as wells J, K, L and M from platforms x and y:

Table 3 - GIGS well and platform ID for southern hemisphere tests

Well	Platform	Input to test procedures
J	x	5512
K	x	5512
L	y	5513
M	y	5513

Other tests in this section examine the geospatial integrity of data exported from the project.

The test dataset files for these tests are synthetic P7/2000 format text files (file extension .P7). An equivalent spreadsheet (.xls) file is also provided for geoscience software that cannot handle the P7/2000 format. For each test the expected output coordinates are given in a spreadsheet (.xls) output file. This section also includes tests to examine the ability of the geoscience software to handle other industry data exchange formats.

Test procedure:	**GIGS 5506. Import wellbore location from geographic CRS coordinates.**
Test purpose:	To verify that the geoscience software can correctly load wellbore data when the horizontal position is given in geographic 2D (latitude/longitude) coordinates. This test compliments that in test procedure GIGS 5526.
Test method:	1. Load data from test file to project *GIGS_project_A2V1depth*. 2. Check horizontal locations in project *GIGS_project_A2V1depth* against test data.
Test data:	*GIGS_well_A_input_[version_date].P7.*
Expected results:	The conversion of geographical coordinates to grid coordinates is required. See file *GIGS_well_A_output_[version_date].xls.* (This output file also applies to test procedure GIGS 5526). Results should agree to within 0.03m of the test data. Test result will be pass or fail. If fail, details of failure should be recorded.
Issues:	• In the input file, the geodesy is defined through reference to EPSG rather than explicitly (as allowed in the P7/2000 format). The identified system is geographic 3D (see test procedure GIGS 5526 for of the vertical component). • The input data are also used in test procedure GIGS 5526 and need to be loaded only once. • If the geoscience software cannot import a P7/2000 format file, report this and instead use the xls input file of similar name.

Test procedure:	**GIGS 5507. Import wellbore location from projected CRS coordinates.**
Test purpose:	To verify that the geoscience software can correctly load vertical wellbore data when the horizontal position is given in map coordinates. No change of CRS is required.
Test method:	1. Load data from test file to project *GIGS_project_A2V1depth*. 2. Check horizontal locations in project *GIGS_project_A2V1depth* against test data.
Test data:	*GIGS_well_B_input_[version_date].P7.*
Expected results:	See file *GIGS_well_B_output_[version_date].xls.* Results should agree to within 0.01m of the test data. Test result will be pass or fail. If fail, details of failure should be recorded.
Issues:	• The input data are also used in test procedure GIGS 5517 and need to be loaded only once. • If the software cannot import a P7/2000 format file, report this and instead use the xls input file of similar name.

Test procedure:	**GIGS 5508. Import wellbore location with projection change.**
Test purpose:	To verify that the geoscience software correctly imports vertical wellbore data when the horizontal position given in map coordinates requires converting to a different projected CRS (map projection change only).
Test method:	1. Load data from test file to project GIGS_project_A2V1depth. 2. Check horizontal locations in project GIGS_project_A2V1depth against test data.
Test data:	*GIGS_well_D_input_[version_date].P7.*
Expected results:	See file *GIGS_well_D_output_[version_date].xls.* Results should agree to within 0.03m of the test data. Test result will be pass or fail. If fail, details of failure should be recorded.
Issues:	• The input data are also used in test procedure GIGS 5515 and need to be loaded only once. • If the software cannot import a P7/2000 format file, report this and instead use the xls input file of similar name.

Test procedure:	**GIGS 5509. Import wellbore location with geodetic datum change**
Test purpose:	To verify that the geoscience software correctly imports vertical wellbore data when the horizontal position is given in geographic coordinates and requires converting to a CRS using a different geodetic datum
Test method:	1. Load data from test file to project *GIGS_project_A2V1depth*. 2. Check horizontal locations in project *GIGS_project_A2V1depth* against test data.
Test data:	*GIGS_well_G_input_[version_date].P7.*
Expected results:	See file *GIGS_well_G_output_[version_date].xls*. Results should agree to within 0.03m of the test data. Test result will be pass or fail. If fail, details of failure should be recorded.
Issues:	• The input data are also used in test procedure GIGS 5516 and need to be loaded only once. • If the software cannot import a P7/2000 format file, report this and instead use the xls input file of similar name.

Test procedure:	**GIGS 5510. Import wellbore horizontal location from measured data relative to true north (northern hemisphere).**
Test purpose:	To verify that the geoscience software can correctly load horizontal position from deviated wellbore survey data given as measured depth, inclination and azimuth with azimuth referenced to true north. This test compliments that in test procedure GIGS 5514.
Test method:	1. Load data from test file to project *GIGS_project_A2V1depth*. 2. Check horizontal locations in project *GIGS_project_A2V1depth* against test data.
Test data:	*GIGS_well_XE_input_[version_date].P7,* and *GIGS_well_XH_input_[version_date].P7.*
Expected results:	See file *GIGS_well_XE_output_[version_date].xls* and *GIGS_well_XH_output_[version_date].xls*. Results should agree to within 0.03m of the test data. Test result will be pass or fail. If fail, details of failure should be recorded.
Issues:	• The well reference point coordinates are referenced to a geographic CRS and should be converted to the project CRS in the software loading process. • Both input wells XE and XH should be tested: their wellbores are orthogonal to each other. • The input data are also used in test procedure GIGS 5514 and need to be loaded only once.

Test procedure:	**GIGS 5511. Import wellbore horizontal location from measured data relative to grid north (northern hemisphere).**
Test purpose:	To verify that the geoscience software can correctly load horizontal position from deviated wellbore data given as measured depth, inclination and azimuth, with azimuth referenced to grid north and wellhead location requires change of map projection. This test compliments that in test procedure GIGS 5515.
Test method:	1. Load data from test file to project *GIGS_project_A2V1depth*. 2. Check horizontal locations in project *GIGS_project_A2V1depth* against test data.
Test data:	*GIGS_well_YC_input_[version_date].P7,* and *GIGS_well_YF_input_[version_date].P7.*
Expected results:	See files *GIGS_well_YC_output_[version_date].xls* and *GIGS_well_YF_output_[version_date].xls*. Results should agree to within 0.03m of the test data. Test result will be pass or fail. If fail, details of failure should be recorded.
Issues:	• Wellhead coordinates are defined through offsets from a facility reference point. See figures above. • The well reference point coordinates are given in a different projected CRS to that of the project and correct conversion in the software loading process should be checked. • Both input wells YC and YF should be tested: their wellbores are orthogonal to each other. • The input data are also used in test procedure GIGS 5515 and need to be loaded only once.

Test procedure:	**GIGS 5512. Import wellbore horizontal location from measured data relative to true north (southern hemisphere).**
Test purpose:	To verify that the geoscience software can correctly load horizontal position from deviated wellbore survey data given as measured depth, inclination and azimuth with azimuth referenced to true north for a well located in the southern hemisphere.
Test method:	1. Load data from test file to project *GIGS_project_F7V1depth*. 2. Check horizontal locations in project *GIGS_project_F7V1depth* against test data.
Test data:	*GIGS_well_xJ_input_[version_date].P7*, and *GIGS_well_xK_input_[version_date].P7.*
Expected results:	See file *GIGS_well_xJ_output_[version_date].xls* and *GIGS_well_xK_output_[version_date].xls*. Results should agree to within 0.03m of the test data. Test result will be pass or fail. If fail, details of failure should be recorded.
Issues:	• Grid convergence may be used in the calculation of position from measured data (it does not necessarily have to be). Whilst the magnitude of grid convergence is defined by map projection formulae, there are two opposing conventions for the sign of the grid convergence. To ensure that the software performance in this area is fully understood this test procedures repeats test procedure GIGS 5510 in a southern hemisphere scenario. • The well reference point coordinates are referenced to a geographic CRS and should be converted to the project CRS in the software loading process. • Both input wells xJ and xK should be tested; their wellbores are orthogonal to each other.

Test procedure:	**GIGS 5513. Import wellbore horizontal location from measured data relative to grid north (southern hemisphere).**
Test purpose:	To verify that the geoscience software can correctly load horizontal position from deviated wellbore data given as measured depth, inclination and azimuth, with azimuth referenced to grid north and wellhead location requires change of map projection, for a well located in the southern hemisphere.
Test method:	1. Load data from test file to project *GIGS_project_F7V1depth*. 2. Check horizontal locations in project *GIGS_project_F7V1depth* against test data.
Test data:	*GIGS_well_yL_input_[version_date].P7*, and *GIGS_well_yM_input_[version_date].P7.*
Expected results:	See files *GIGS_well_yL_output_[version_date].xls* and *GIGS_well_yM_output_[version_date].xls*. Results should agree to within 0.03m of the test data. Test result will be pass or fail. If fail, details of failure should be recorded.
Issues:	• See test procedure 5512 for grid convergence comment. This test procedure repeats that in GIGS 5511 for a soutrhern hemisphere location. • Wellhead coordinates are defined through offsets from a facility reference point. See figures above. • The well reference point coordinates are given in a different projected CRS to that of the project and correct conversion in the software loading process should be checked. • Both input wells yL and yM should be tested; their wellbores are orthogonal to each other.

Test procedure:	**GIGS 5514. Import wellbore vertical location from measured data relative to true north (northern hemisphere).**
Test purpose:	To verify that the geoscience software can correctly load vetical position from deviated wellbore survey data given as measured depth, inclination and azimuth with azimuth referenced to true north. This test compliments that in test procedure GIGS 5510.
Test method:	1. Load data from test files to project *GIGS_project_A2V1depth*. 2. Check vertical locations in project *GIGS_project_A2V1depth* against test data.
Test data:	*GIGS_well_XE_input_[version_date].P7*, and *GIGS_well_XH_input_[version_date].P7.*
Expected results:	See files *GIGS_well_XE_output_[version_date].xls* and *GIGS_well_XH_output_[version_date].xls*. Results should agree to within 0.03m of the test data. Test result will be pass or fail. If fail, details of failure should be recorded.
Issues:	The input data are also used in test procedure 5510 and need to be loaded only once.

Test procedure:	**GIGS 5515. Import wellbore vertical location from measured data relative to grid north (northern hemisphere).**
Test purpose:	To verify that the geoscience software can correctly load vertical position from deviated wellbore data given as measured depth, inclination and azimuth, with azimuth referenced to grid north and well reference point requires change of vertical datum. This test compliments those in test procedures GIGS 5508 and GIGS 5511.
Test method:	1. Load data from test files to project *GIGS_project_A2V1depth*. 2. Check vertical locations in project *GIGS_project_A2V1depth* against test data.
Test data:	*GIGS_well_D_input_[version_date].P7,* *GIGS_well_YC_input_[version_date].P7,* and *GIGS_well_YF_input_[version_date].P7.*
Expected results:	See files *GIGS_well_D_output_[version_date].xls*, *GIGS_well_YC_output_[version_date].xls*, and *GIGS_well_YF_output_[version_date].xls*. Results should agree to within 0.03m of the test data. Test result will be pass or fail. If fail, details of failure should be recorded.
Issues:	• The input data are also used in test procedures GIGS 5508 and GIGS 5511 and need to be loaded only once. • The well reference point coordinates are referenced to a CRS with a different vertical datum to that of the project and correct transformation in the software loading process should be checked.

Test procedure:	**GIGS 5516. Import wellbore depth data with TVDBML reference.**
Test purpose:	To verify that the geoscience software can correctly load vertical position from wellbore data referenced to TVDBML.
Test method:	1. Load data from test files to project *GIGS_project_A2V1depth*. 2. Check vertical locations in project *GIGS_project_A2V1depth* against test data.
Test data:	*GIGS_well_G_input_[version_date].P7.*
Expected results:	The software should adjust depths below mud line to be depths below project vertical CRS. See file *GIGS_well_G_output_[version_date].xls*. Results should agree to within 0.03m of the test data. Test result will be pass or fail. If fail, details of failure should be recorded.
Issues:	The input data are also used in test procedure 5509 and need to be loaded only once.

Test procedure:	**GIGS 5526. Import wellbore depth data with ellipsoidal vertical data.**
Test purpose:	To verify that the geoscience software can correctly load wellbore vertical position when referenced to a different vertical datum to that of the project. This test compliments that in test procedure GIGS 5506.
Test method:	1. Load data from test files to project *GIGS_project_A2V1depth*. 2. Check vertical locations in project *GIGS_project_A2V1depth* against test data.
Test data:	*GIGS_well_A_input_[version_date].P7.*
Expected results:	The software should adjust depths below ellipsoid to be depths below project vertical CRS using the EGM96 goiid model. See file *GIGS_well_A_output_[version_date].xls*. Results should agree to within 0.03m of the test data. Test result will be pass or fail. If fail, details of failure should be recorded.
Issues:	The input data are also used in test procedure 5506 and need to be loaded only once.

Test procedure:	**GIGS 5517. Import wellbore depth data with vertical unit change.**
Test purpose:	To verify that the geoscience software can correctly load vertical position when referenced to a different vertical CRS to that of the project.
Test method:	1. Load data from test files to project *GIGS_project_A2V1depth*. 2. Check vertical locations in project *GIGS_project_A2V1depth* against test data.
Test data:	*GIGS_well_B_input_[version_date].P7.*
Expected results:	The software should convert depth data given in feet to metres. See file *GIGS_well_B_output_[version_date].xls*. Results should agree to within 0.03m of the test data. Test result will be pass or fail. If fail, details of failure should be recorded.
Issues:	The input data are also used in test procedure 5507 and need to be loaded only once.

If test procedures 5506 through 5517 and 5526 have been successful and if the software has the facility to display well cross sections, then in project *GIGS_project_A2V1depth* create a cross section through the bottom hole locations of wells A, B, YC, D, XE, YF, G and YH. The bottom hole locations of all eight wellbores should fall in a straight line in the horizontal plane and

another straight line in the vertical plane. The intersection of the wellbores A, B, YC, D and XE with horizon 1 should lie on a straight line in the vertical plane; the intersection of the wellbores YF, G and XH with horizon 1 should lie on another straight line in the vertical plane; between XE and YF there should be a 20m vertical fault throw. See the cross section in figure 10.

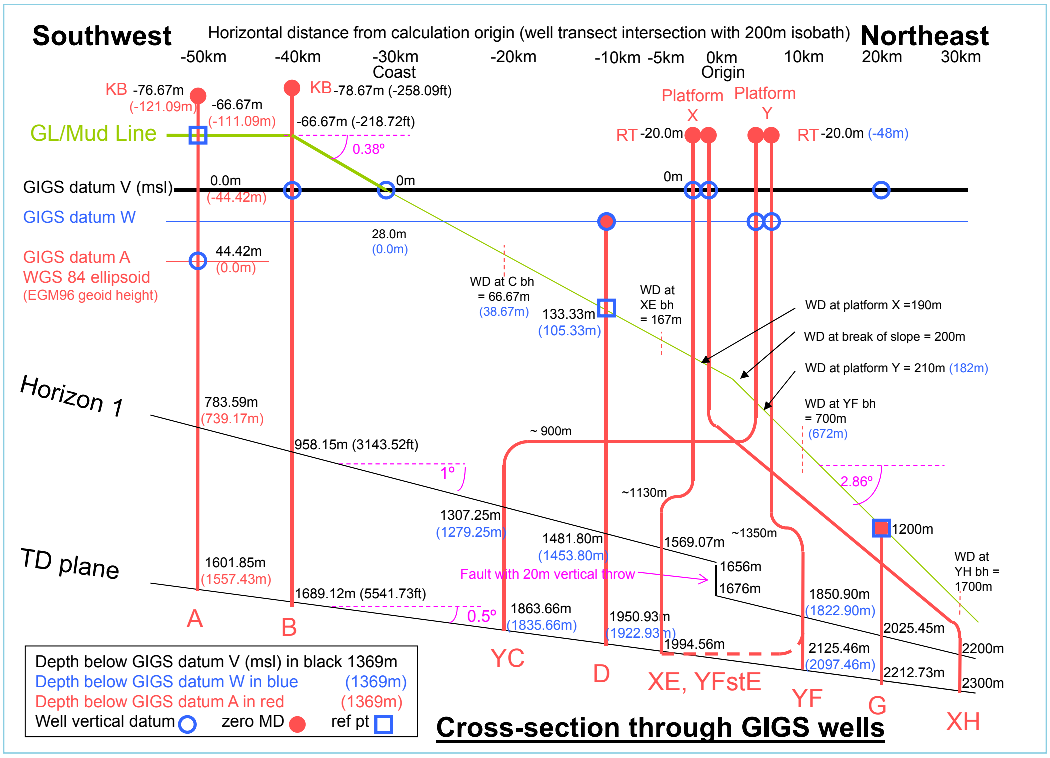

Figure 10 - Well cross section

Test procedure:	**GIGS 5518. Export wellbore data with projection change.**
Test purpose:	To verify that the geoscience software correctly exports wellbore data when a change of map projection is required.
Test method:	1. In project *GIGS_project_A2V1depth*, export the test data. 2. Verify coordinates in exported data file against test data.
Test data:	Well GIGS-B from project *GIGS_project_A2V1depth*, with exported horizontal coordinates to be referenced to GIGS_projCRS_A1.
Expected results:	• The software exports horizontal locations correctly. Pass/fail. • The software exports CRS definition correctly. Pass/fail. See file *GIGS_well_5518-21-22-25_output_v1-1_[version_date].xls*. (The same output file applies to all of test procedures 5518, 5521, 5522 and 5525).
Issues:	• This test assumes that well B has been correctly loaded to the project (see test procedure GIGS 5507). • The test data is also used in test procedure GIGS 5521.

Test procedure:	**GIGS 5519. Export wellbore data with geographic CRS change.**
Test purpose:	To verify that the geoscience software correctly exports wellbore data when a change of geographic CRS is required.
Test method:	1. In project *GIGS_project_A2V1depth*, export data as described in test data. 2. Verify coordinates in exported data file against test data.
Test data:	Well GIGS-D from project from project *GIGS_project_A2V1depth*, with exported horizontal coordinates to be referenced to *GIGS_geogCRS_B*.
Expected results:	• The software exports horizontal locations correctly. Pass/fail. • The software exports CRS definitions correctly. Pass/fail. See file *GIGS_well_5519_output_[version_date].xls*.
Issues:	This test assumes that well D has been correctly loaded to the project (see test procedure GIGS 5508).

Test procedure:	**GIGS 5520. Export wellbore data with change of horizontal CRS units.**
Test purpose:	To verify that the geoscience software correctly exports wellbore data when a change of horizontal CRS unit is involved.
Test method:	1. In project *GIGS_project_A2V1depth*, export data as described in test data. 2. Verify coordinates in exported data file against test data.
Test data:	Well GIGS-G from project *GIGS_project_A2V1depth*, with exported horizontal coordinates to be referenced to *GIGS_projCRS_A23*.
Expected results:	• The software exports horizontal locations correctly. Pass/fail. • The software exports CRS definition correctly. Pass/fail. See file *GIGS_well_5520-24_output_v1-1_2010-02-11.xls*. (The same output file applies to both of test procedures GIGS 5520 and GIGS 5524).
Issues:	This test assumes that well G has been correctly loaded to the project (see test procedure GIGS 5509).

Test procedure:	**GIGS 5521. Export wellbore data with vertical CRS change.**
Test purpose:	To verify that the geoscience software correctly exports wellbore data when a change of vertical CRS is involved.
Test method:	1. In project *GIGS_project_A2V1depth* export data as described in test data. 2. Verify coordinates in exported data file against test data.
Test data:	Well GIGS-B from project *GIGS_project_A2V1depth*, with exported horizontal coordinates to be referenced to *GIGS_projCRS_A1* and exported vertical coordinates to be referenced to *GIGS_vertCRS_W1 depth*.
Expected results:	• The software exports vertical locations correctly. Pass/fail. • The software exports CRS definition correctly. Pass/fail. See file *GIGS_well_5518-21-22-25_output_v1-1_[version_date].xls*. (The same output file applies to all of test procedures 5518, 5521, 5522 and 5525).
Issues:	• This test assumes that well B has been correctly loaded to project A7V (see test procedure 5507). • The test data is also used for test procedure GIGS 5518.

Test procedure:	**GIGS 5522. Transfer wellbore data with projection change.**
Test purpose:	To verify that the geoscience software correctly transfers wellbore data to another project when a change of map projection is required.
Test method:	1. In project *GIGS_project_A2V1depth* select test data. 2. Transfer to project *GIGS_project_A1W1depth*. 3. Verify data in project *GIGS_project_A1W1depth* against test data.
Test data:	Well GIGS-B as loaded to project *GIGS_project_A2V1depth*.
Expected results:	The software transfers horizontal locations correctly. See file *GIGS_well_5518-21-22-25_output_v1-1_[version_date].xls*. (The same output file applies to all of test procedures 5518, 5521, 5522 and 5525). Pass/fail.
Issues:	• This test involves a change of CRS from source project CRS to target project CRS. The test assumes that the software applies a coordinate change and then stores coordinates in the CRS to which the target project is referenced. • The test assumes that well B has been correctly loaded to the source project A7V (see test procedure 5507). • The test data is also used for test procedure GIGS 5525. • The software should retain an audit trail of coordinate change actions. See Series 6000 tests.

Test procedure:	**GIGS 5523. Transfer wellbore data with geographic CRS change.**
Test purpose:	To verify that the geoscience software correctly transfers wellbore data to another project when a change of geodetic datum is required.
Test method:	1. In project *GIGS_project_A2V1depth* select test data. 2. Transfer to project *GIGS_project_B2V1depth*. 3. Verify data in project *GIGS_project_B2V1depth* against test data.
Test data:	Well GIGS-D as loaded to project *GIGS_project_A2V1depth*.
Expected results:	The software transfers horizontal locations correctly. See file *GIGS_well_5523_output_[version_date].csv*. Pass/fail.
Issues:	• This test involves a change of CRS from the CRS to which the source project is referenced to the CRS to which the target project is referenced. The test assumes that the software applies a coordinate change and then stores coordinates in the CRS to which the target project is referenced. • The test assumes that well D has been correctly loaded to the source project (see test procedure GIGS 5508).

Test procedure:	**GIGS 5524. Transfer wellbore data with horizontal CRS unit change.**
Test purpose:	To verify that the geoscience software correctly transfers wellbore data to another project when a change of horizontal CRS unit is involved.
Test method:	1. In project *GIGS_project_A2V1depth* select test data. 2. Transfer selected data to project *GIGS_project_A23V1depth*. 3. Verify data in project *GIGS_project_A23V1depth* against test data.
Test data:	Well GIGS-G as loaded to project *GIGS_project_A2V1depth*.
Expected results:	The software transfers horizontal locations correctly. See file *GIGS_well_5520-24_output_v1-1_[version_date].xls*. (The same output file applies to both of test procedures GIGS 5520 and GIGS 5524). Pass/fail.
Issues:	• This test involves a change of CRS from the CRS to which the source project is referenced to the CRS to which the target project is referenced. The test assumes that the software applies a coordinate change and then stores coordinates in the CRS to which the target project is referenced. • The test assumes that well G has been correctly loaded to the source project (see test procedure GIGS 5509).

Test procedure:	**GIGS 5525. Transfer wellbore data with vertical CRS change.**
Test purpose:	To verify that the geoscience software correctly transfers wellbore data to another project when a change of vertical CRS is involved.
Test method:	1. In project *GIGS_project_A2V1depth* select test data. 2. Transfer selected data to project *GIGS_project_A1W1depth*. 3. Verify data in project *GIGS_project_A1W1depth* against test data.
Test data:	Well GIGS-B as loaded to project *GIGS_project_A2V1depth*.
Expected results:	The software transfers vertical locations correctly. See file *GIGS_well_5518-21-22-25_output_v1-1_[version_date].xls*. (The same output file applies to all of test procedures 5518, 5521, 5522 and 5525). Pass/fail.
Issues:	• This test involves a change of vertical datum from source project to target project. The test assumes that the software applies a coordinate change and then stores coordinates in the CRS to which the target project is referenced. • The test assumes that well B has been correctly loaded to the source project (see test procedure *5507*).

Test procedure:	**GIGS 5526. Import wellbore depth data with ellipsoidal vertical data.**
	This is detailed with other import procedures, preceding test procedure GIGS 5517 above.

6 – Test data and procedures – series 6000 – audit trail

Test procedure:	**GIGS 6001. Import UKOOA P1/90 file header.**
Test purpose:	To verify whether the geoscience software correctly loads CRS information from a UKOOA P1/90 format file with traditional CRS definition records.
Test method:	1. Load test data to project *GIGS_project_A2V1depth*. 2. Verify.
Test data:	*GIGS_seis2D_5306_input_[version_date].P1.*
Expected results:	• The software stores original CRS definition. Pass/fail. • The software stores audit trail of CRS change applied. Pass/fail.
Issues:	• This test involves a change of CRS from that to which input data is referenced to that which the project is referenced. • The test data was loaded in test procedure GIGS 5306 and should not need to be reloaded.

Test procedure:	**GIGS 6002. Import UKOOA P1/90 file header with EPSG db reference.**
Test purpose:	To verify whether the geoscience software correctly loads CRS information from a UKOOA P1/90 format file with EPSG CRS definition records.
Test method:	1. Load test data to project *GIGS_project_A2V1depth*. 2. Verify.
Test data:	*GIGS_seis2D_5307_input_[version_date].P1.*
Expected results:	• The software stores original CRS definition. Pass/fail. • The software stores audit trail of CRS change applied. Pass/fail.
Issues:	• This test involves a change of CRS from that to which input data is referenced to that which the project is referenced. • The test data was loaded in test procedure GIGS 5307 and should not need to be reloaded.

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7 – Test data and procedures – series 7000 – deprecation

Test procedure:	**GIGS 7001. Deprecated EPSG data.**
Test purpose:	To verify whether reference data bundled with the geoscience software recognises the EPSG deprecation flag.
Test method:	Review definitions of EPSG deprecated data included in the geoscience software.
Test data:	EPSG Dataset and file *GIGS_7001_libDeprecatedData_[version_date].xls*. As a minimum those deprecated records included within file *GIGS_7001_libDeprecatedData_[version_date].xls* should be examined.
Expected results:	Data marked as deprecated in the EPSG Dataset should either be clearly distinguished from valid data or should not be present in the geoscience software libraries.
Issues:	Software may lag behind updates to the EPSG Dataset. The test data deliberately uses deprecations made several years ago, which by now should be recognised as deprecated by the geoscience software.

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Appendix 1 – Index to the GIGS test data

Test Series	Test Procedure Reference #	GIGS test	Test data input file name(s)	GIGS CRS(s) used	Expected output file
2000	**Pre-defined geodetic parameter library**				
	2001	unit of measure	GIGS_2001_libUnit_[version_date].xls		(n/a)
	2002	ellipsoid	GIGS_2002_libEllipsoid_[version_date].xls		(n/a)
	2003	prime meridian	GIGS_2003_libPrimeMeridian_[version_date].xls		(n/a)
	2004	geodetic datum & CRS	GIGS_2004_libGeodeticDatumCRS_[version_date].xls		(n/a)
	2005	map projection	GIGS_2005_libProjection_[version_date].xls		(n/a)
	2006	projected CRS	GIGS_2006_libProjectedCRS_[version_date].xls		(n/a)
	2007	coordinate transformation	GIGS_2007_libGeodTfm_[version_date].xls		(n/a)
	2008	vertical datum/vertical CRS	GIGS_2008_libVerticalDatumCRS_[version_date].xls		(n/a)
	2009	vertical transformation	GIGS_2009_libVertTfm_[version_date].xls		(n/a)
3000	**User-defined geodetic parameter library**				
	3001	unit of measure	GIGS_3001_userUnit_[version_date].xls		(n/a)
	3002	ellipsoid	GIGS_3002_userEllipsoid_[version_date].xls		(n/a)
	3003	prime meridian	GIGS_3003_userPrimeMeridian_[version_date].xls		(n/a)
	3004	geodetic datum & CRS	GIGS_3004_userGeodeticDatum_[version_date].xls		(n/a)
	3005	map projection	GIGS_3005_userProjection_[version_date].xls		(n/a)
	3006	projected CRS	GIGS_3006_userProjectedCRS_[version_date].xls		(n/a)
	3007	coordinate transformation	GIGS_3007_userGeodTfm_[version_date].xls		(n/a)
	3008	vertical datum/vertical CRS	GIGS_3008_userVerticalDatum_[version_date].xls		(n/a)
	3009	vertical transformation	GIGS_3009_userVertTfm_[version_date].xls		(n/a)
	3010	concatenated transformation	GIGS_3010_userConcatTfm_[version_date].xls		(n/a)
4000	**User Interface**				
	4001	Software behaviour - Axes	(Use EPSG Dataset as test data)		(n/a)
5100	**Data Operations - Map Projections**				
	5101	Software performance - Conversions - Transverse Mercator	GIGS _conv_5101_TM_input_[version_date].xls	A<>A1 A<>A2 F<>F7 G<>G11	GIGS_conv_51xx_output_[version_date].xls, worksheet 5101 TM
	5102	Software performance - Conversions - Lambert Conic Conformal (1SP)	GIGS _conv_5102_LCC1_input_[version_date].xls	M<>M25 H<>H19	GIGS_conv_51xx_output_[version_date].xls, worksheet 5102 LCC1

Test Series	Test Procedure Reference #	GIGS test	Test data input file name(s)	GIGS CRS(s) used	Expected output file
	5103	Software performance - Conversions - Lambert Conic Conformal (2SP)	GIGS _conv_5103_LCC2_input_[version_date].xls	E<>E6 G<>G17 G<>G18	GIGS_conv_51xx_output_[version_date].xls, worksheet 5103 LCC2
	5104	Software performance - Conversions - Oblique Stereographic	GIGS_conv_5104_OblStereo_input_[version_date].xls	C<>C4	GIGS_conv_51xx_output_[version_date].xls, worksheet 5104 OblStereo
	5105	Software performance - Conversions - Oblique Mercator	GIGS _conv_5105_HOM-B_input_[version_date].xls	G<>G13 K<>K26	GIGS_conv_51xx_output_[version_date].xls, worksheet 5105 HOM-B
	5106	Software performance - Conversions - Hotine Oblique Mercator	GIGS_conv_5106_HOM-A_input_[version_date].xls	G<>G14	GIGS_conv_51xx_output_[version_date].xls, worksheet 5106 HOM-A
	5107	Software performance - Conversions - American Polyconic	GIGS_conv_5107_AmPolyC_input_[version_date].xls	G<>G12	GIGS_conv_51xx_output_[version_date].xls, worksheet 5107 AmPolyC
	5108	Software performance - Conversions - Cassini-Soldner	GIGS_conv_5108_Cass_input_[version_date].xls	G<>G15	GIGS_conv_51xx_output_[version_date].xls, worksheet 5108 Cass
	5109	Software performance - Conversions - Albers Equal Area	GIGS_conv_5109_Albers_input_[version_date].xls	F<>F9	GIGS_conv_51xx_output_[version_date].xls, worksheet 5109 Albers
	5110	Software performance - Conversions - Lambert Azimuthal Equal Area	GIGS_conv_5110_LAEA_input_[version_date].xls	G<>G16	GIGS_conv_51xx_output_[version_date].xls, worksheet 5110 LAEA
	5111	Software performance - Conversions - Mercator (1SP)	GIGS _conv_5111_MercA_input_[version_date].xls	L<>L27 D<>D5	GIGS_conv_51xx_output_[version_date].xls, worksheet 5111 MercA
	5112	Software performance - Conversions - Mercator (2SP)	GIGS_conv_5112_MercB_input_[version_date].xls	Y<>Y24	GIGS_conv_51xx_output_[version_date].xls, worksheet 5112 MercB
	5113	Software performance - Conversions - Transverse Mercator (South Orientated)	GIGS_conv_5113_TMSO_input_[version_date].xls	G<>G10	GIGS_conv_51xx_output_[version_date].xls, worksheet 5113 TMSO
5200	**Data Operations - Transformations and conversions other than map projections**				
	5201	Software performance - Conversions - Geographic<>Geocentric	GIGS_conv_5201_GeogGeocen_input_[version_date].xls	A	GIGS_tfm_52xx_output_[version_date].xls, worksheet 5201 GeogGeocen
	5202	(test deleted and replaced by tests 5211 through 5213)			
	5203	Software performance - transformations - Position Vector (geographic 2D domain)	GIGS_tfm_5203_PosVec_input_[version_date].xls	B<>A	GIGS_tfm_52xx_output_[version_date].xls, worksheet 5203 PosVec
	5204	Software performance - transformations - Coordinate Frame (geographic 2D domain)	GIGS_tfm_5204_CoordFrame_input_[version_date].xls	E<>A	GIGS_tfm_52xx_output_[version_date].xls, worksheet 5204 CoordFrame

Test Series	Test Procedure Reference #	GIGS test	Test data input file name(s)	GIGS CRS(s) used	Expected output file
	5205	Software performance - transformations - Molodensky-Badekas (geographic domain)	GIGS_tfm_5205_MolBad_input_[version_date].xls	C<>A	GIGS_tfm_52xx_output_[version_date].xls, worksheet 5205 MolBad
	5206	Software performance - transformations - NADCON	GIGS_tfm_5206_Nadcon_input_[version_date].xls	J<>Z	GIGS_tfm_52xx_output_[version_date].xls, worksheet 5206 NADCON
	5207	Software performance - transformations - NTv2	GIGS_tfm_5207_NTv2_input_[version_date].xls	X<>F and J<>Z	GIGS_tfm_52xx_output_[version_date].xls, worksheet 5207 NTv2
	5208	Software performance - transformations - Longitude rotation	GIGS_tfm_5208_LonRot_input_[version_date].xls	T<>H	GIGS_tfm_52xx_output_[version_date].xls, worksheet 5208 LonRot
	5209	Software performance - conversions - UKOOA P6 bin grid	GIGS_conv_5209_P6_input_[version_date].xls	A1	GIGS_tfm_52xx_output_[version_date].xls, worksheet 5209 P6
	5210	Software performance - transformations - vertical offset	GIGS_tfm_5210_VertOff_input_[version_date].xls	W1<>V1 with both heights and depths	GIGS_tfm_52xx_output_[version_date].xls, worksheet 5210 VertOff
	5211	Software performance - transformations - geocentric translations (geocentric domain)	GIGS_tfm_5211_3translation_Geocen_input_[version_date].xls	B<>A	GIGS_tfm_52xx_output_[version_date].xls, worksheet 5211 3trnslt_geocen
	5212	Software performance - transformations - geocentric translations (geographic 3D domain)	GIGS_tfm_5212_3translation_Geog3D_input_[version_date].xls	B<>A	GIGS_tfm_52xx_output_[version_date].xls, worksheet 5212 3trnslt_geog3D
	5213	Software performance - transformations - geocentric translations (geographic 2D domain)	GIGS_tfm_5213_3translation_Geog2D_input_[version_date].xls	B<>A	GIGS_tfm_52xx_output_[version_date].xls, worksheet 5213 3trnslt_geog2D
5300	**Data Operations - 2D Seismic**				
	5306	Import 2D seismic location data with projection change (1) - full CRS definition.	GIGS_seis2D_5306_input_[version_date].P1 (GIGS_seis2D_5306_input_[version_date].csv as alternate)	A1>A2	GIGS_seis2D_5306-5315_output_[version_date].xls
	5307	Import 2D seismic location data with projection change (2) - EPSG CRS identification.	GIGS_seis2D_5307_input_[version_date].P1 (GIGS_seis2D_5307_input_[version_date].csv as alternate)	A1>A2	GIGS_seis2D_5306-5315_output_[version_date].xls
	5308	Import 2D seismic location data with geodetic datum change (1) - full CRS definition.	GIGS_seis2D_5308_input_[version_date].P1 (GIGS_seis2D_5308_input_[version_date].csv as alternate)	B>A2	GIGS_seis2D_5306-5315_output_[version_date].xls
	5309	Import 2D seismic location data with geodetic datum change (2) - EPSG CRS identification.	GIGS_seis2D_5309_input_[version_date].P1 (GIGS_seis2D_5309_input_[version_date].csv as alternate)	B>A2	GIGS_seis2D_5306-5315_output_[version_date].xls
	5310	Import 2D seismic location data with change of horizontal units	GIGS_seis2D_5310_input_[version_date].P1 (GIGS_seis2D_5310_input_[version_date].csv as alternate)	A23>A2	GIGS_seis2D_5306-5315_output_[version_date].xls

Test Series	Test Procedure Reference #	GIGS test	Test data input file name(s)	GIGS CRS(s) used	Expected output file
	5311	Import 2D seismic location data given in grads	GIGS_seis2D_5311_input_[version_date].P1 (GIGS_seis2D_5311_input_[version_date].csv as alternate)	Agr>A2	GIGS_seis2D_5306-5315_output_[version_date].xls
	5312	Import 2D seismic location data with vertical datum change.	GIGS_seis2D_5312_input_[version_date].P1 (GIGS_seis2D_5312_input_[version_date].csv as alternate)	W1height > V1depth and W1depth > V1depth	GIGS_seis2D_5306-5315_output_[version_date].xls
	5313	Import 2D seismic location data with ellipsoidal height.	GIGS_seis2D_5313_input_[version_date].P1 (GIGS_seis2D_5313_input_[version_date].csv as alternate)	A>V1depth	GIGS_seis2D_5306-5315_output_[version_date].xls
	5314	Import 2D seismic location data with change of vertical units.	GIGS_seis2D_5314_input_[version_date].P1 (GIGS_seis2D_5314_input_[version_date].csv as alternate)	V2height > V1depth	GIGS_seis2D_5306-5315_output_[version_date].xls
	5315	Import and "decimate" 2D seismic location data	GIGS_seis2D_5315_input_[version_date].P1 (GIGS_seis2D_5315_input_[version_date].csv as alternate)	n/a	GIGS_seis2D_5306-5315_output_[version_date].xls
	5316	Export 2D seismic location data with projection change.	(test data loaded to project in earlier tests)	A2>A1	GIGS_seis2D_5316_output_[version_date].P1 (GIGS_seis2D_5320-16_output_[version_date].xls as alternate)
	5317	Export 2D seismic location data with geodetic datum change.	(test data loaded to project in earlier tests)	A2>B2	GIGS_seis2D_5317_output_[version_date].P1 (GIGS_seis2D_5321-17_output_[version_date].xls as alternate)
	5318	Export 2D seismic location data with change of horizontal units.	(test data loaded to project in earlier tests)	A2>A23	GIGS_seis2D_5318_output_[version_date].P1 (GIGS_seis2D_5322-18_output_[version_date].xls as alternate)
	5319	Export 2D seismic location data with vertical datum change.	(test data loaded to project in earlier tests)	V1depth > W1depth	GIGS_seis2D_5319_output_[version_date].P1 (GIGS_seis2D_5323-19_output_[version_date].xls as alternate)
	5320	Transfer 2D seismic location data with projection change.	(test data loaded to project in earlier tests)	A2>A1	GIGS_seis2D_5320-16_output_[version_date].xls
	5321	Transfer 2D seismic location data with geodetic datum change.	(test data loaded to project in earlier tests)	A2>B2	GIGS_seis2D_5321-17_output_[version_date].xls
	5322	Transfer 2D seismic location data with change of horizontal CRS units.	(test data loaded to project in earlier tests)	A2>A23	GIGS_seis2D_5322-18_output_[version_date].xls
	5323	Transfer 2D seismic location data with vertical datum change.	(test data loaded to project in earlier tests)	V1depth > W1depth	GIGS_seis2D_5323-19_output_[version_date].xls
	5324	Import 2D seismic location data with geodetic datum change using NADCON	GIGS_seis2D_5324_input_[version_date].P1	J>Z	GIGS_seis2D_5324-25_output_[version_date].xls
	5325	Import 2D seismic location data with geodetic datum change using NTv2	GIGS_seis2D_5325_input_[version_date].P1	J>Z	GIGS_seis2D_5324-25_output_[version_date].xls
5400	**Data Operations - 3D Seismic**				
	5403	Import 3D seismic location data with CRS change	GIGS_seis3D_5403_input_surveyA_[version_date].P6 GIGS_seis3D_5403_input_surveyB_[version_date].P1 GIGS_seis3D_5403_input_surveyC_[version_date].P6 GIGS_seis3D_5403_input_surveyD_[version_date].P6 (GIGS_seis3D_5403_input_surveysACD_not_P6_[version_date].xls as alternate)	A1>A2	GIGS_seis2D_5306-5315_output_[version_date].xls

Test Series	Test Procedure Reference #	GIGS test	Test data input file name(s)	GIGS CRS(s) used	Expected output file
	5404	Export 3D seismic location data with CRS change.	GIGS_seis3D_5404-5_input_[version_date].txt	A2>A1	GIGS_seis3D_5404-5_output_[version_date].xls
	5405	Transfer 3D seismic location data with CRS change.	GIGS_seis3D_5404-5_input_[version_date].txt	A2>A1	GIGS_seis3D_5404-5_output_[version_date].xls
	5406	Import P6 extent and coverage records	GIGS_seis3D_5406-7_input_[version_date].P6	A2	(n/a)
	5407	Import P6 extent records with projection change	GIGS_seis3D_5406-7_input_[version_date].P6	A2>A1	GIGS_seis3D_5407_output_[version_date].xls
5500	**Data Operations - Well Data**				
	5506	Import wellbore location data from latitude, longitude	GIGS_well_A_input_[version_date].P7 (.xls as alternative)	A1>A2	GIGS_seis2D_5306-5315_output_[version_date].xls
	5507	Import wellbore location data from EN	GIGS_well_B_input_[version_date].P7 (.xls as alternative)	A2	GIGS_well_B_output_[version_date].xls
	5508	Import wellbore location data from different EN	GIGS_well_D_input_[version_date].P7 (.xls as alternative)	A1>A2	GIGS_well_D_output_[version_date].xls
	5509	Import wellbore location data from different geodetic datum	GIGS_well_G_input_[version_date].P7 (.xls as alternative)	B>A2	GIGS_well_G_output_[version_date].xls
	5510	Import wellbore location data from MD/Inc/Az - TN	GIGS_well_XE_input_[version_date].P7 (.xls as alternative) GIGS_well_XH_input_[version_date].P7 (.xls as alternative)	A2	GIGS_well_XE_output_[version_date].xls GIGS_well_XH_output_[version_date].xls
	5511	Import wellbore location data from MD/Inc/Az - GN	GIGS_well_YC_input_[version_date].P7 (.xls as alternative) GIGS_well_YF_input_[version_date].P7 (.xls as alternative)	A1>A2	GIGS_well_YC_output_[version_date].xls GIGS_well_YF_output_[version_date].xls
	5512	Import wellbore location data from MD/Inc/Az - TN (Southern Hemisphere)	GIGS_well_xJ_input_[version_date].P7 (.xls as alternative) GIGS_well_xK_input_[version_date].P7 (.xls as alternative)	F>F1	GIGS_well_xJ_output_[version_date].xls GIGS_well_xK_output_[version_date].xls
	5513	Import wellbore location data from MD/Inc/Az - GN (Southern Hemisphere)	GIGS_well_yL_input_[version_date].P7 (.xls as alternative) GIGS_well_yM_input_[version_date].P7 (.xls as alternative)	F7>F1	GIGS_well_yL_output_[version_date].xls GIGS_well_yM_output_[version_date].xls
	5514	Import wellbore depth data from MD/Inc/Az	GIGS_well_XE_input_[version_date].P7 (.xls as alternative) GIGS_well_XH_input_[version_date].P7 (.xls as alternative)	V1 depth	GIGS_well_XE_output_[version_date].xls GIGS_well_XH_output_[version_date].xls
	5515	Import wellbore depth data with change of vertical datum	GIGS_well_D_input_[version_date].P7 (.xls as alternative) GIGS_well_YC_input_[version_date].P7 (.xls as alternative) GIGS_well_YF_input_[version_date].P7 (.xls as alternative)	W1 depth > V1 depth	GIGS_well_D_output_[version_date].xls GIGS_well_YC_output_[version_date].xls GIGS_well_YF_output_[version_date].xls

Test Series	Test Procedure Reference #	GIGS test	Test data input file name(s)	GIGS CRS(s) used	Expected output file
	5516	Import wellbore depth data with TVDBML reference	GIGS_well_G_input_[version_date].P7 (.xls as alternative)	V1 depth	GIGS_well_G_output_[version_date].xls
	5517	Import wellbore depth data with change of vertical CRS unit	GIGS_well_B_input_[version_date].P7 (.xls as alternative)	V1depth ft and m	GIGS_well_B_output_[version_date].xls
	5518	Export wellbore data with projection change.	(n/a)	A2>A1	GIGS_well_5518-21-22-25_output_v1-1_[version_date].xls
	5519	Export wellbore data with geodetic datum change.	(n/a)	A2>B	GIGS_well_5519_output_v1-1_[version_date].xls
	5520	Export wellbore data with change of horizontal CRS units.	(n/a)	A2>A23	GIGS_well_5520-24_output_v1-1_[version_date].xls
	5521	Export wellbore data with vertical datum change.	(n/a)	V1 depth > W1 depth	GIGS_well_5518-21-22-25_output_v1-1_[version_date].xls
	5522	Transfer wellbore data with projection change.	(n/a)	A2>A1	GIGS_well_5518-21-22-25_output_v1-1_[version_date].xls
	5523	Transfer wellbore data with geodetic datum change.	(n/a)	A2>B	GIGS_well_5523_output_v1-1_[version_date].xls
	5524	Transfer wellbore data with change of horizontal CRS units.	(n/a)	A2>A23	GIGS_well_5520-24_output_v1-1_[version_date].xls
	5525	Transfer wellbore data with vertical datum change.	(n/a)	V1 depth > W1 depth	GIGS_well_5518-21-22-25_output_v1-1_[version_date].xls
	5526	Import wellbore depth data referenced to ellipsoidal height	GIGS_well_A_input_[version_date].P7 (.xls as alternative)	A > V1 depth	GIGS_well_A_output_[version_date].xls
6000	**Audit Trail**				
	6001	Import P1/90 header	GIGS_seis2D_5306_input_[version_date].P1	A1>A2	
	6002	Import P1/90 EPSG header	GIGS_seis2D_5307_input_[version_date].P1	A2	
7000	**Deprecation**				
	7001	Recognise EPSG deprecated data	GIGS_7001_libDeprecatedData_[version_date].xls	(n/a)	GIGS_7001_libDeprecatedData_[version_date].xls

Appendix 2 – Tips for conducting test procedures when the geoscience software does not conform to the EPSG model or nomenclature

The ISO/EPSG model represents the consensus of best practice that has evolved over 20 years of digital geospatial data management. It is assumed that future geoscience software will follow the model. However the current generation of geoscience software does not always do so. The GIGS Test Dataset may be used with such geoscience software if the software's model can be mapped to the ISO/EPSG model. In this document it is impossible to cover all non-conformant cases. Commonly encountered issues are:

- Nomenclature.
- Axes names and abbreviations and coordinate order may be hard-wired into the software rather than being dependent upon CRS definition.
- Units.
- Although not part of any formal CRS definition, some geoscience software requires that a datum definition includes a transformation to WGS 84.

Nomenclature

The most common problem is the use of '*coordinate system*' to mean the ISO/EPSG entity *coordinate reference system*. In the ISO/EPSG model, coordinate system is just one part of a CRS. Other commonly encountered terms are '*datum shift*' for coordinate transformation, and '*spheroid*' for ellipsoid.

The names of coordinate conversion and coordinate transformation methods may sometimes be problematic. Where particular terms are known to be encountered, these are noted in the relevant tests in sections 5.1 and 5.2. Another problem is one method name may be used for formula that give significantly different results. This will become apparent when results do not correspond with the "expected results" in the test dataset.

The names of coordinate conversion and transformation method parameters may sometimes be problematic. One term may be used for all of *latitude of origin, latitude of natural origin* and *latitude of false origin*; similarly for longitude with the added complication that it may be called '*central meridian*'. *False easting, easting at false origin* and *easting at projection centre* may all be called '*false easting*'; similarly for false northing.

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Appendix 3 – Mapping of GIGS and EPSG names and codes

The convention adopted for GIGS coordinate reference system names is:

- Each entity is assigned a name and, in case geoscience software requires it, a code. GIGS codes are integer numbers in the range 60000 to 69999.
- The entity name describes its type and includes a letter or number which is unique within that type. For geodetic CRSs the EPSG subtypes geocentric and geographic 3D are embedded in the name but in the names of geographic 2D CRSs, the '2D' is omitted.
- Datum names include a letter, for example "GIGS geodetic datum A" or "GIGS vertical datum U".
- CRSs using that datum take the same letter, for example "GIGS geogCRS B" is a geographic 2D CRS which uses geodetic datum B.
- Map projection names include a number, for example "GIGS projection 3".
- Projected CRS names include the letter for the base geographic CRS and the number for the map projection, for example "GIGS projCRS B3" is based on CRS and geodetic datum B and map projection 3.
- Vertical CRS names include the letter for the datum, a number to indicate axis unit, and the words height or depth to indicate positive axis direction.
- For coordinate transformations, the name is not given explicitly but if needed can be built implicitly by following the EPSG Dataset convention of "[Source CRS name] to [Target CRS name] [variant number]".

The correspondence between GIGS CRSs and "real world systems" as documented in the EPSG Dataset is shown in Table 4 and Table 5 below, with the understanding that the official EPSG CRSs are limited to their specified "area of use" as defined in the EPSG Dataset, whereas the corresponding GIGS CRSs have unlimited area of use (i.e., they may be used for any geographic area of the Earth).

The EPSG names and codes are equivalent to the GIGS names and codes for "late binding" systems only (i.e., for CRS and datums not requiring coordinate transformations as part of the datum definition).

For some real-world geodetic datums and geographic CRS entities, multiple GIGS entities are created. The duplicate entities, indicated by the prime sign ('), are necessary only for software that requires a transformation to WGS 84 to be part of the datum or CRS definition (so called "early binding"). [Note: 'Early binding' is adopted in some software as a means of implementing coordinate transformations. In the real world datums and CRSs are stand-alone entities capable of existing without their relationship to WGS 84 being defined].

Table 4 - GIGS and EPSG equivalences for geodetic datums and CRSs

GIGS name	GIGS code	Object Type	EPSG name	EPSG code
GIGS geodetic datum A	66001	Geodetic datum	World Geodetic System 1984	6326
GIGS geocenCRS A	64001	Geocentric CRS	WGS 84	4978
GIGS geog3DCRS A	64002	Geographic 3D CRS	WGS 84	4979
GIGS geogCRS A GIGS geogCRS Agr	64003 64033[7]	Geographic 2D CRS	WGS 84	4326
GIGS geogCRS Alonlat	64004	Geographic 2D CRS	WGS 84 with CS axes reversed. No equivalent in EPSG Dataset	N/A
GIGS geodetic datum B GIGS geodetic datum B′	66002 66017[8]	Geodetic datum	OSGB 1936	6277

7 - Latitude and longitude for GIGS geogCRS A in degrees, for GIGS geogCRS Agr in grads
8 - Specific for early binding with EPSG transformation 1314

GIGS name	GIGS code	Object Type	EPSG name	EPSG code
GIGS geog3DCRS B GIGS geog3DCRS B′	64019 66024[8]	Geographic 3D CRS	*OSGB 1936 with ellipsoidal height. No equivalent in EPSG Dataset*	N/A
GIGS geogCRS B GIGS geogCRS B′	64005 64023[8]	Geographic 2D CRS	OSGB 1936	4277
GIGS geogCRS C GIGS geodetic datum C′	66003 66018[9]	Geographic 2D CRS	Amersfoort	6289
GIGS geog3DCRS C GIGS geog3DCRS C′	64021 64026[9]	Geographic 3D CRS	*Amersfoort with ellipsoidal height. No equivalent in EPSG Dataset*	N/A
GIGS geogCRS C GIGS geogCRS C′	64006 64025[9]	Geographic 2D CRS	Amersfoort	4289
GIGS geodetic datum D	66004	Geodetic datum	Batavia (Jakarta)	6813
GIGS geogCRS D	64007	Geographic 2D CRS	Batavia (Jakarta)	4813
GIGS geodetic datum E GIGS geodetic datum E′	66005 66023[10]	Geodetic datum	Reseau National Belge 1972	6313
GIGS geog3DCRS E GIGS geog3DCRS E′	64022 64028[10]	Geographic 3D CRS	*Belge 1972 with ellipsoidal height. No equivalent in EPSG Dataset*	N/A
GIGS geogCRS E GIGS geogCRS E′	64008 64027[10]	Geographic 2D CRS	Belge 1972	4313
GIGS geodetic datum F	66006	Geodetic datum	Geocentric Datum of Australia 1994	6283
GIGS geogCRS F	64009	Geographic 2D CRS	GDA94	4283
GIGS geodetic datum G	66007	Geodetic datum	Functionally equivalent to any ITRF-based Geodetic datum in *EPSG Dataset*	See footnote[11]
GIGS geogCRS G	64010	Geographic 2D CRS	Functionally equivalent to any ITRF-based Geog2D system in *EPSG Dataset*	See footnote[11]
GIGS geodetic datum H	66008	Geodetic datum	Nouvelle Triangulation Francaise (Paris)	6807
GIGS geogCRS H	64011	Geographic 2D CRS	NTF (Paris)	4807
GIGS geodetic datum J GIGS geodetic datum J′ GIGS geodetic datum J′′ GIGS geodetic datum J′′′	66009 66021[12] 66019[13] 66020[14]	Geodetic datum	North American Datum 1927	6267
GIGS geogCRS J GIGS geogCRS J′ GIGS geogCRS J′′ GIGS geogCRS J′′′	64012 64029[12] 64030[13] 64031[14]	Geographic 2D CRS	NAD27	4267
GIGS geodetic datum AA	66326	Geodetic datum	World Geodetic System 1984	6326
GIGS geogCRS AA	64326	Geographic 2D CRS	WGS 84	4326
GIGS geodetic datum BB	66277	Geodetic datum	OSGB 1936	6277
GIGS geogCRS BB	64277	Geographic 2D CRS	OSBG36	4277
GIGS geodetic datum CC	66289	Geodetic datum	Amersfoort	6289

9 - Specific for early binding with GIGS coordinate transformation 61003
10 - Specific for early binding with EPSG coordinate transformation 15929
11 - For late binding systems only this CRS is functionally equivalent to any ITRS realisation using the GRS 1980 ellipsoid including ETRS89, GDM2000, NAD83(HARN), POSGAR98, SIRGAS 2000, et al (e.g., EPSG CRS codes 4258, 4742, 4269 4152, 4190, 4674, et al)
12 - Specific for early binding with EPSG coordinate transformation 1243
13 - Specific for early binding with EPSG coordinate transformation 1241
14 - Specific for early binding with EPSG coordinate transformation 1693

GIGS name	GIGS code	Object Type	EPSG name	EPSG code
GIGS geogCRS CC	64289	Geographic 2D CRS	Amersfoort	4289
GIGS geodetic datum DD	66813	Geodetic datum	Batavia (Jakarta)	6813
GIGS geogCRS DD	64813	Geographic 2D CRS	Batavia (Jakarta)	4813
GIGS geodetic datum EE	66313	Geodetic datum	Reseau National Belge 1972	6313
GIGS geogCRS EE	64313	Geographic 2D CRS	Belge 72	4313
GIGS geodetic datum FF	66283	Geodetic datum	Geocentric Datum of Australia 1994	6283
GIGS geogCRS FF	64283	Geographic 2D CRS	GDA94	4283
GIGS geodetic datum HH	66807	Geodetic datum	Nouvelle Triangulation Francaise (Paris)	6283
GIGS geogCRS HH	64807	Geographic 2D CRS	NTF (Paris)	4283
GIGS geodetic datum ZZ	66269	Geodetic datum	North American Datum 1983	6269
GIGS geogCRS ZZ	64269	Geographic 2D CRS	NAD83	4269
GIGS geodetic datum K	66012	Geodetic datum	Hungarian Datum 1972	6237
GIGS geogCRS K	64015	Geographic 2D CRS	HD72	4237
GIGS geodetic datum L	66011	Geodetic datum	Batavia	6211
GIGS geogCRS L	64014	Geographic 2D CRS	Batavia	4211
GIGS geodetic datum M	66016	Geodetic datum	European Datum 1950	6230
GIGS geogCRS M	64020	Geographic 2D CRS	ED50	4230
GIGS geodetic datum T	66010	Geodetic datum	Nouvelle Triangulation Francaise	6275
GIGS geogCRS T	64013	Geographic 2D CRS	NTF	4275
GIGS geodetic datum X GIGS geodetic datum X'	66013 66022[15]	Geodetic datum	Australian Geodetic datum 1966	6202
GIGS geogCRS X GIGS geogCRS X'	64016 64032[15]	Geographic 2D CRS	AGD66	4202
GIGS geodetic datum Y	66014	Geodetic datum	Pulkovo 1942	6284
GIGS geogCRS Y	64017	Geographic 2D CRS	Pulkovo 1942	4284
GIGS geodetic datum Z	66015	Geodetic datum	North American Datum 1983	6269
GIGS geogCRS Z	64018	Geographic 2D CRS	NAD83	4269
GIGS projCRS A1	62001	Projected CRS	WGS 84 / UTM zone 31N	32631
GIGS projCRS A1-2	62002	Projected CRS	*Equivalent to WGS 84 / UTM zone 31N with different CS. No equivalent in EPSG Dataset.*	N/A
GIGS projCRS A1-3	62003	Projected CRS	*Equivalent to WGS 84 / UTM zone 31N with different CS. No equivalent in EPSG Dataset.*	N/A
GIGS projCRS A1-4	62004	Projected CRS	*Equivalent to WGS 84 / UTM zone 31N with different CS. No equivalent in EPSG Dataset.*	N/A
GIGS projCRS A1-5	62005	Projected CRS	*Equivalent to WGS 84 / UTM zone 31N with different CS. No equivalent in EPSG Dataset.*	N/A
GIGS projCRS A1-6	62006	Projected CRS	*Equivalent to WGS 84 / UTM zone 31N with different CS. No equivalent in EPSG Dataset.*	N/A
GIGS projCRS A2	62007	Projected CRS	*Equivalent to WGS 84 / British National Grid.*[16]	N/A
GIGS projCRS A21[17]	62008	Projected CRS	*Equivalent to WGS 84 / British National Grid (GIGS projCRS A2) but defined in an alternative way.*	N/A

15 - Specific for early binding with EPSG coordinate transformation 15786
16 - For GIGS purposes only - no equivalent system exists in the real world.
17 - To be used as an alternative to GIGS projCRS A2 if the software is unable to define a Transverse Mercator projection with latitude of natural origin not on the equator.

GIGS name	GIGS code	Object Type	EPSG name	EPSG code
GIGS projCRS A23	62027	Projected CRS	Equivalent to WGS 84 / UTM zone 31N in US survey feet[16]. No equivalent in EPSG Dataset.	N/A
GIGS projCRS B2	62009	Projected CRS	OSGB 1936 / British National Grid	27700
GIGS projCRS B22[18]	62010	Projected CRS	Equivalent to OSGB 1936/British National Grid (GIGS projCRS B2), but defined in an alternative way.	N/A
GIGS projCRS C4	62011	Projected CRS	Amersfoort / RD New	28992
GIGS projCRS D5	62012	Projected CRS	No equivalent in EPSG Dataset, but would be Batavia (Jakarta) / NEIEZ Jakarta	N/A
GIGS projCRS E6	62013	Projected CRS	Belge 1972 / Belgian Lambert 72	31370
GIGS projCRS F7	62014	Projected CRS	GDA94 / MGA zone 54	28354
GIGS projCRS F8	62015	Projected CRS	GDA94 / MGA zone 55	28355
GIGS projCRS F9	62016	Projected CRS	GDA94 / Australian Albers	3577
GIGS projCRS G10	62017	Projected CRS	Hartebeesthoek94 / Lo21	2049
GIGS projCRS G11	62018	Projected CRS	POSGAR 98 / Argentina 5	22175
GIGS projCRS G12	62019	Projected CRS	Functionally equivalent to SIRGAS / Brazil Polyconic[16].	N/A
GIGS projCRS G13	62020	Projected CRS	No exact equivalent in *EPSG Dataset* but this CRS is in practice equivalent to GDM2000 / East Malaysia BRSO defined using OM rather than HOM method. See GIGS projCRS G14 below.	N/A
GIGS projCRS G14	62021	Projected CRS	GDM2000 / East Malaysia BRSO	3376
GIGS projCRS G15	62022	Projected CRS	GDM2000 / Johor Grid	3377
GIGS projCRS G16	62023	Projected CRS	ETRS89 / ETRS-LAEA	3035
GIGS projCRS G17	62024	Projected CRS	NAD83(HARN) / Utah North (ft)	2921
GIGS projCRS G18	62025	Projected CRS	NAD83(HARN) / Utah North (ftUS)	3568
GIGS projCRS H19	62026	Projected CRS	NTF (Paris) / Lambert zone II	27572
GIGS projCRS J28	62038	Projected CRS	NAD27 / UTM zone 8N	26708
GIGS projCRS K26	62036	Projected CRS	HD72 / EOV	23700
GIGS projCRS L27	62037	Projected CRS	Batavia / NEIEZ	3001
GIGS projCRS M25	62035	Projected CRS	ED50 / France EuroLambert	2192
GIGS projCRS Y24	62034	Projected CRS	Pulkovo 1942 / Caspian Sea Mercator	3388
GIGS projCRS Z28	62039	Projected CRS	NAD83 / UTM zone 8N	26908
GIGS projCRS AA1	62028	Projected CRS	WGS 84 / UTM zone 31N	32631
GIGS projCRS BB2	62029	Projected CRS	OSGB 1936 / British National Grid	27700
GIGS projCRS CC4	62030	Projected CRS	Amersfoort / RD New	28992
GIGS projCRS EE6	62031	Projected CRS	Belge 1972 / Belgian Lambert 72	31370
GIGS projCRS FF8	62032	Projected CRS	GDA94 / MGA zone 54	28354
GIGS projCRS HH19	62033	Projected CRS	NTF (Paris) / Lambert zone II	27572

The above table provides GIGS and EPSG equivalences only for geodetic datums and CRSs. Other GIGS geodetic objects correspond to real world geodetic objects as documented in the EPSG Dataset. These are further shown in the tables below. Again, where an official EPSG object is limited to a specified "area of use" as defined in the EPSG Dataset, the corresponding GIGS geodetic object is understood to have an unlimited area of use (i.e., they may be used for any geographic area of the Earth).

18 - To be used as an alternative to GIGS projCRS B2 if the software is unable to define a Transverse Mercator projection with latitude of natural origin not on the equator.

Table 5 - GIGS and EPSG equivalence for other geodetic objects

GIGS name	GIGS code	Object Type	EPSG name	EPSG code
GIGS ellipsoid A	67030	Ellipsoid	WGS 84	7030
GIGS ellipsoid B	67001	Ellipsoid	Airy 1830	7001
GIGS ellipsoid C	67004	Ellipsoid	Bessel 1841	7004
GIGS ellipsoid E	67022	Ellipsoid	International 1924	7022
GIGS ellipsoid F	67019	Ellipsoid	Not in the EPSG Dataset, but is equivalent to GRS80 (code 7019) expressed in kilometres	N/A
GIGS ellipsoid H	67011	Ellipsoid	Clarke 1880 (IGN)	7011
GIGS ellipsoid I	67052	Ellipsoid	*Clarke 1866 Authalic Sphere*	7052
GIGS ellipsoid J	67008	Ellipsoid	Not in the EPSG Dataset, but is equivalent to Clarke 1866 (code 7008) expressed in US survey feet	N/A
GIGS ellipsoid K	67036	Ellipsoid	GRS 1967	7036
GIGS ellipsoid X	67003	Ellipsoid	*Australian National Spheroid*	7003
GIGS ellipsoid Y	67024	Ellipsoid	Krassowsky 1940	7024
GIGS PM A	68901	Prime Meridian	Greenwich	8901
GIGS PM A	68908	Prime Meridian	Jakarta	8908
GIGS PM A	68903	Prime Meridian	Paris	8903
GIGS PM A	68904	Prime Meridian	Bogota	8904
GIGS projection 1	65001	Map projection	UTM zone 31N	16031
GIGS projection 2	65002	Map projection	British National Grid	19916
GIGS projection 2 Alt A	65021	Map projection	*Not in the EPSG Dataset*	N/A
GIGS projection 2 Alt B	65022	Map projection	*Not in the EPSG Dataset*	N/A
GIGS projection 4	65004	Map projection	RD New	19914
GIGS projection 5	65005	Map projection	No exact equivalent in the EPSG Dataset but equivalent to 19905 if referenced to Jakarta meridian	N/A
GIGS projection 6	65006	Map projection	Belgian Lambert 72	19961
GIGS projection 7	65007	Map projection	Australian Map Grid zone 54	17454
GIGS projection 8	65008	Map projection	Australian Map Grid zone 55	17455
GIGS projection 9	65009	Map projection	Australian Albers	17365
GIGS projection 10	65010	Map projection	South African Survey Grid zone 21	17521
GIGS projection 11	65011	Map projection	Argentina zone 5	18035
GIGS projection 12	65012	Map projection	Brazil Polyconic	19941
GIGS projection 13	65013	Map projection	Not in the EPSG Dataset, but would be equivalent to 19894 if defined using Hotine Oblique Mercator (variant B) method	N/A
GIGS projection 14	65014	Map projection	East Malaysia BRSO	19894
GIGS projection 15	65015	Map projection	Johor Grid	19893
GIGS projection 16	65016	Map projection	Europe Equal Area 2001	19986
GIGS projection 17	65017	Map projection	Utah North (ft)	15262
GIGS projection 18	65018	Map projection	Utah North (ftUS)	15297
GIGS projection 19	65019	Map projection	Lambert zone II	18082
GIGS projection 23	65023	Map projection	Not in the EPSG Dataset, but would be equivalent to UTM zone 31N using US survey feet (ftUS)	N/A
GIGS projection 24	65024	Map projection	Caspian Sea Mercator	19884
GIGS projection 25	65025	Map projection	France EuroLambert	18086

GIGS name	GIGS code	Object Type	EPSG name	EPSG code
GIGS projection 26	65026	Map projection	EOV	19931
GIGS projection 27	65027	Map projection	NEIEZ	19905
GIGS projection 28	65028	Map projection	UTM zone 8N	16008
GIGS geogCRS A to WGS 84 (1)	61001	coordinate transformation	Null transformation for WGS 84 to WGS 84 (Not in EPSG Dataset)	N/A
GIGS geogCRS B to GIGS geogCRS A (1)	61196	coordinate transformation	OSGB 1936 to WGS 84 (2)	1196
GIGS geogCRS B to GIGS geogCRS A (2)	1314	coordinate transformation	OSGB 1936 to WGS 84 (6)	1314
GIGS geogCRS C to GIGS geogCRS A (1)	61002	coordinate transformation	No equivalent exists in the EPSG Dataset	N/A
GIGS geogCRS C to GIGS geogCRS A (2)	15934	coordinate transformation	Amersfoort to WGS 84 (3)	15934
GIGS geogCRS C to GIGS geogCRS A (3)	61003	coordinate transformation	Equivalent to EPSG Amersfoort to ETRS89 (4) to within the accuracy of the transformation	N/A
GIGS geogCRS D to GIGS geogCRS L (1)	61759	coordinate transformation	Batavia (Jakarta) to Batavia (1)	1759
GIGS geogCRS E to GIGS geogCRS A (1)	61610	coordinate transformation	BD72 to WGS 84 (2)	1610
GIGS geogCRS E to GIGS geogCRS A (2)	15929	coordinate transformation	BD72 to WGS 84 (3)	15929
GIGS geogCRS F to GIGS geogCRS A (1)	61150	coordinate transformation	GDA94 to WGS 84 (1)	1150
GIGS geogCRS H to GIGS geogCRS T (1)	61763	coordinate transformation	NTF (Paris) to NTF (1)	1763
GIGS geogCRS J to GIGS geogCRS A (1)	61173	coordinate transformation	NAD27 to WGS 84 (4)	1173
GIGS geogCRS J to GIGS geogCRS A (2)	61004	coordinate transformation	No equivalent exists in the EPSG Dataset	N/A
GIGS geogCRS J to GIGS geogCRS A (3)	61844	coordinate transformation	NAD27 to NAD83(CSRS) (1)	1844
GIGS geogCRS K to GIGS geogCRS A (1)	61242	coordinate transformation	HD72 to WGS 84 (4)	1242
GIGS geogCRS L to GIGS geogCRS A (1)	61123	coordinate transformation	NAD27 to WGS 84 (1)	1123
GIGS geogCRS M to GIGS geogCRS A (1)	61275	coordinate transformation	ED50 to WGS 84 (17)	1275
GIGS geogCRS T to GIGS geogCRS A (1)	61193	coordinate transformation	NTF to WGS 84 (1)	1193
GIGS geogCRS X to GIGS geogCRS A (1)	15788	coordinate transformation	AGD66 to WGS 84 (16)	15788
GIGS geogCRS Y to GIGS geogCRS A (1)	61254	coordinate transformation	Pulkovo 1942 to WGS 84 (1)	1254
GIGS geogCRS Z to GIGS geogCRS A (1)	61188	coordinate transformation	NAD83 to WGS 84 (1)	1188

Appendix 4 – Definition of project CRS for data operations tests

For the Data Operations tests, test data must be loaded into the geoscience software. This will normally require the creation of a 'project' within the software. To comply with the test scenarios these projects need to be defined to reference specific coordinate reference systems.

GIGS project names have been constructed from the required horizontal and vertical CRS names. For example, "GIGS project A9V1depth" is to be referenced to horizontal CRS "A9" and vertical CRS "V1 depth". The project CRSs are detailed below:

GIGS_project_A2V1depth

This project is used for many of the GIGS well and seismic location import tests. This project should be referenced to the following horizontal and vertical CRSs:

Horizontal CRS: GIGS projCRS A2

Vertical CRS: GIGS vertCRS V1 depth

1. The project area covers the following geographic bounding rectangle:
   north: 52°40'N, south: 51°40'N, west: 1°40'E, east: 3°40'E
2. Horizontal CRS: GIGS projCRS A2

   This is equivalent to the geodetically fictitious CRS WGS 84 / British National Grid except that "A2" is not limited by the associated EPSG Area of Use limitations for the British National Grid projection.

   Defining parameters are built up through test procedures 3001 through 3006 and possibly 3007.

   Alternatively, if the required pre-defined library components are available, the CRS could be defined through association of the British National Grid projection with WGS 84 geodetic datum and an appropriate Cartesian coordinate system, assuming that associated EPSG area of use limitations are overridden.

   Note: this can only be done in software in which the ellipsoid parameters are part of the datum definition and are not part of the projection definition.

   Horizontal CRS components:

   Ellipsoid: GIGS ellipsoid A, a = 6,378,137.0m, 1/f = 298.2572236 (= WGS 84, EPSG ellipsoid code 7030)
   Prime meridian: GIGS PM A (= Greenwich, EPSG prime meridian code 8901)
   Geodetic datum: name = GIGS geodetic datum A. (= WGS 84, EPSG datum code 6326)
   (Coordinate transformation relationship to WGS 84: geocentric translations dX=dY=dZ=0)

   Map projection: GIGS projection 2 (= British National Grid, EPSG projection code 19916):

   method = Transverse Mercator (= EPSG coordinate operation method code 9807)
   latitude of natural origin = 49°N
   longitude of natural origin = 2°W
   scale factor at natural origin = 0.9996012717
   false easting = 400,000.0 metres
   false northing = -100,000.0 metres (note: minus)

   Coordinate system: (= EPSG coordinate system code 4400):

   first axis = easting, direction = east, abbreviation = E, units = metre
   second axis = northing, direction = north, abbreviation = N, units = metre
3. Vertical CRS: GIGS vertCRS V1 depth

   This is equivalent to the CRS Baltic depth (EPSG CRS code 5612) which has no geodetic validity in the project area but, for GIGS purposes, has been assumed to have global applicability.

For GIGS purposes in case the software "assumes" a vertical datum of mean sea level (msl), this CRS has been defined (through GIGS coordinate transformation code 61501) to be equal to unspecified msl depth (EPSG CRS code 5715).

Defining parameters are built up through test procedures 3008 and possibly GIGS 3009.

Vertical CRS components:

Vertical datum (= EPSG datum code 5105):

name = GIGS vertical datum V

Coordinate system (= EPSG coordinate system code 6498):

axis = gravity-related depth, direction = down, abbreviation = D, unit = metre

GIGS_project_F7V1depth

This project is used for some GIGS well tests.

This project should be referenced to the following horizontal and vertical CRSs:

Horizontal: GIGS projCRS F7

Vertical: GIGS vertCRS V1 depth

1. The project area covers the following geographic bounding rectangle:

   north: 51°40'S, south: 52°40'S, west: 139°40'E, east: 141°40'E

2. Horizontal CRS: GIGS projCRS F7

   This GIGS projCRS F7 is equivalent to the EPSG CRS GDA 94 / MGA zone 54 (EPSG CRS code 28354) except "F7" is not limited by the associated EPSG Area of Use for that CRS.

   Defining parameters are built up through test procedures GIGS 3001 through 3006 and possibly 3007.

   Horizontal CRS definitions as follows:

   Ellipsoid: GIGS ellipsoid A, a = 6,378,137.0m, 1/f = 298.2572221 (= GRS 80, EPSG ellipsoid code 7019)
   Prime meridian: GIGS PM A (= Greenwich, EPSG prime meridian code 8901)
   Geodetic datum: name = GIGS geodetic datum F. (= GDA 94, EPSG datum code 6283)
   (Coordinate transformation relationship to WGS 84: geocentric translations dX=dY=dZ=0)

   Map projection: GIGS projection 7 (= MGA zone 54, EPSG projection code 17354):

   method = Transverse Mercator (= EPSG coordinate operation method code 9807)
   latitude of natural origin = 0°N
   longitude of natural origin = 141°E
   scale factor at natural origin = 0.9996
   false easting = 500,000.0 metres
   false northing = 10,000,000.0 metres

   Coordinate system (= EPSG coordinate system code 4400):

   first axis = easting, direction = east, abbreviation = E, units = metre
   second axis = northing, direction = north, abbreviation = N, units = metre

3. Vertical CRS GIGS vertCRS V1 depth

   See GIGS_project_A2V1depth.

GIGS_project_A1W1depth

This project is used for some GIGS seismic location and wellbore transfer tests. This project should be referenced to the following horizontal and vertical CRSs:

Horizontal: GIGS projCRS A1

Vertical: GIGS vertCRS W1 depth

1. The project area covers the following geographic bounding rectangle:
   north: 52°40'N, south: 51°40'N, west: 1°40'E, east: 3°40'E
2. Horizontal CRS: GIGS projCRS A1

   This is equivalent to EPSG CRS WGS 84 / UTM zone 31N (EPSG CRS code 32631) except that "A1" is not limited by the associated EPSG Area of Use for that CRS.

   Defining parameters are built up through test procedures GIGS 3001 through 3006 and possibly 3007.

   Horizontal CRS components:

   ellipsoid: GIGS ellipsoid A, a = 6,378,137.0m, 1/f = 298.2572236 (= WGS 84, EPSG ellipsoid code 7030)
   prime meridian: GIGS PM A (= Greenwich, EPSG prime meridian code 8901)
   geodetic datum: name = GIGS geodetic datum A (= WGS 84, EPSG datum code 6326)
   (Coordinate transformation relationship to WGS 84: geocentric translations dX=dY=dZ=0)

   Map projection: GIGS projection 1 (= UTM zone 31N, EPSG projection code 16031):

      method = Transverse Mercator (= EPSG coordinate operation method code 9807)
      latitude of natural origin = 0°N
      longitude of natural origin = 3°E
      scale factor at natural origin = 0.9996
      false easting = 500,000.0 metres
      false northing = 0.0 metres

   Coordinate system (= EPSG coordinate system code 4400):

      first axis = easting, direction = east, abbreviation = E, units = metre
      second axis = northing, direction = north, abbreviation = N, units = metre
3. Vertical CRS "GIGS vertCRS W1 depth

   This is equivalent to the EPSG CRS Caspian depth (EPSG CRS code 5706) which has no geodetic validity in the project area but, for GIGS purposes, has been assumed to have global applicability.

   For GIGS purposes in case the software "assumes" a vertical datum of msl, this vertical datum has been defined (through GIGS coordinate transformation codes 65440, 65441, 65400 and 65438) to be equal to 28m below GIGS vertical datum V which, as elsewhere, has been defined to be equal to unspecified msl.

   Defining parameters are built up through test procedure GIGS 3008 and possibly GIGS 3009.

   Vertical CRS components:

   Vertical datum: name = GIGS vertical datum W (= EPSG datum code 5105)

   Coordinate system (= EPSG coordinate system code 6498):

      axis = gravity-related depth, direction = down, abbreviation = D, unit = metre

GIGS_project_A23V1depth

This project is used for some GIGS seismic location and wellbore transfer tests. This project should be referenced to the following horizontal and vertical CRSs, which are defined below:

Horizontal: GIGS projCRS A23

Vertical: GIGS vertCRS V1 depth

1. The project area covers the following geographic bounding rectangle:

   north: 52°40'N, south: 51°40'N, west: 1°40'E, east: 3°40'E

2. Horizontal CRS: GIGS projCRS A23

   This is equivalent to WGS 84 / UTM zone 31N in US survey feet. There is no equivalent to this fictitious CRS in the EPSG Dataset.

   Defining parameters are built up through test procedures GIGS 3001 through 3006 and possibly 3007.

   Horizontal CRS components:

   ellipsoid: GIGS ellipsoid A, a = 6,378,137.0m, 1/f = 298.2572236 (= WGS 84, EPSG ellipsoid code 7030)
   prime meridian: GIGS PM A (= Greenwich, EPSG prime meridian code 8901)
   geodetic datum: name = GIGS geodetic datum A (= WGS 84, EPSG datum code 6326)
   (Coordinate transformation relationship to WGS 84: geocentric translations dX=dY=dZ=0)

   Map projection: GIGS projection 23.

   method = Transverse Mercator (= EPSG coordinate operation method code 9807)
   latitude of natural origin = 0°N
   longitude of natural origin = 3°E
   scale factor at natural origin = 0.9996
   false Easting = 1,640,416.667 US survey feet
   false Northing = 0.0 US survey feet
   1 US survey foot = 12/39.37 metres

   Coordinate system (= EPSG coordinate system code 4497):

   first axis = easting, direction = east, abbreviation = X, units = US survey foot
   second axis = northing, direction = north, abbreviation = Y, units = US survey foot

3. Vertical CRS: GIGS vertCRS V1 depth

   See GIGS_project_A2V1depth.

GIGS_project_B2V1depth

This project is used for some GIGS seismic location and wellbore transfer tests. This project should be referenced to the following horizontal and vertical CRSs,

Horizontal: GIGS projCRS B2

Vertical: GIGS vertCRS V1 depth

1. The project area covers the following geographic bounding rectangle:

    north: 52°40'N, south: 51°40'N, west: 1°40'E, east: 3°40'E

2. Horizontal CRS: GIGS projCRS B2

    This is equivalent to EPSG CRS OSGB 1936 / British National Grid (EPSG CRS code 27700) except that for GIGS purposes the area of applicability is fictitiously extended. That is, GIGS ProjCRS B1 is not limited by the associated EPSG Area of Use for EPSG Code 27700.

    Defining parameters are built up through test procedures GIGS 3001 through 3006 and possibly 3007.

    Horizontal CRS components:

    ellipsoid: GIGS ellipsoid B, a = 6,377,563.396m, 1/f = 299.3249646 (= Airy 1830, EPSG ellipsoid code 7001)
    prime meridian: GIGS PM A (= Greenwich, EPSG prime meridian code 8901)
    geodetic datum: name = GIGS geodetic datum B (= OSGB 1936, EPSG datum code 6277)

    (For GIGS purposes only, GIGS geogCRS B is defined with the relationship to GIGS geogCRS A (WGS 84): geocentric translations dX=371m, dY=-112 m (note: minus) and dZ=434m)

    map projection: GIGS projection 2 (= British National Grid, EPSG projection code 19916)

    method = Transverse Mercator (= EPSG coordinate operation method code 9807)
    latitude of natural origin = 49°N
    longitude of natural origin = 2°W
    scale factor at natural origin = 0.9996012717
    false easting = 400,000.0 metres
    false northing = -100,000.0 metres (note: minus)

    Coordinate system (= EPSG coordinate system code 4400):

    first axis = easting, direction = east, abbreviation = E, units = metre
    second axis = northing, direction = north, abbreviation = N, units = metre

3. Vertical CRS: GIGS vertCRS V1 depth

    See GIGS_project_A2V1depth.

GIGS_project_Z28V1depth

This project is used for some GIGS seismic location tests. This project should be referenced to the following horizontal and vertical CRSs:

Horizontal: GIGS projCRS Z28

Vertical: GIGS vertCRS V1 depth

1. The project area covers the following geographic bounding rectangle:

   north: 75°N, south: 15°N, west: 165°E, east: 85°W. Note that this crosses the 180° meridian.

2. Horizontal CRS: GIGS projCRS Z28

   This is equivalent to EPSG CRS NAD83 / UTM zone 8N (EPSG CRS code 26908) except that for GIGS purposes the area of applicability is fictitiously extended. That is, GIGS ProjCRS Z28 is not limited by the associated EPSG Area of Use for EPSG Code 26908.

   Defining parameters are built up through test procedures GIGS 3001 through 3006 and possibly 3007.

   Horizontal CRS components:

   ellipsoid: GIGS ellipsoid J, a = 6,378206.4m, 1/f = 294.9786982 (= Clarke 1866, EPSG ellipsoid code 7008)
   prime meridian: GIGS PM A (= Greenwich, EPSG prime meridian code 8901)
   geodetic datum: name = GIGS geodetic datum J (=North American Datum 1927, EPSG datum code 6267)

   (For GIGS purposes only, GIGS geogCRS J is defined with the relationship to GIGS geogCRS A (WGS 84): geocentric translations dX=-8m (note: minus), dY=160m and dZ=176m)

   map projection: GIGS projection 28 (= UTM zone 8N, EPSG projection code 16008)
   method = Transverse Mercator (= EPSG coordinate operation method code 9807)
   latitude of natural origin = 0°N
   longitude of natural origin = 135°W
   scale factor at natural origin = 0.9996
   false easting = 500,000.0 metres
   false northing = 0.0 metres

   Coordinate system (= EPSG coordinate system code 4400):

   first axis = easting, direction = east, abbreviation = E, units = metre
   second axis = northing, direction = north, abbreviation = N, units = metre

3. Vertical CRS: GIGS vertCRS V1 depth

   See GIGS_project_A2V1depth.

Appendix 5 – Precision and presentation

Precision of geodetic metadata

The precision of the geodetic parameters for defining all coordinate operations (coordinate transformations, map projection conversions and other conversions) in the GIGS Test Dataset is identical to that in the same defining parameters within the EPSG Dataset. That is:

- an equivalent number of significant figures for each map projection parameter was used to develop the map projection conversion tests for the GIGS Test Dataset.
- an equivalent number of significant figures for each coordinate transformation parameter was used to develop the coordinate transformation tests for the GIGS Test Dataset

Key portions of the GIGS Test Procedures require that reviewers verify that the precisions of the above as stored and utilised in the geoscience software are at least as high as that for the corresponding parameters stored within the EPSG Dataset. This is tested in two scenarios:

1. For the geoscience software's pre-defined geodetic libraries, the parameter precision for those coordinate operations need to be examined against the EPSG Dataset for compliance and/or non-compliance. This testing is covered in the GIGS Series 2000 (Pre-defined geodetic parameter library) testing.
2. For the geoscience software's ability to allow entry of user-defined geodetic objects, the precision allowed for the user-defined coordinate operations and other allowable geodetic objects needs to be sufficient to allow for storage of equivalent precision to that provided in the User-Defined GIGS Test Dataset. This testing is covered in the GIGS Series 3000 (User-Defined Geodetic Parameter Library) testing.

Resolution and presentation of GIGS test data coordinates

All input coordinates in metres or feet [easting, northing, heights (either ellipsoidal or gravity related), depths, geocentric Cartesian X,Y,Z, etc.], are given to a precision of at least 1 centimetre or 1 hundredth of a foot, respectively.

Latitude and longitude in degrees when in the recommended human interface sexagesimal representation DDD° MM' SS.sss" are input to a precision of 0.001 arc second, a spatial resolution of approximately 3cm (in line with those of the linear units above).

Latitude and longitude in decimal degrees or grads are input to a precision of 0.0000001, that is, DDD.ddddddd (i.e., seven decimal places).

There are currently no plans to provide geographic coordinates of the GIGS test data in any of the following representations or units:

- coordinates in the sexagesimal representation DDD.mmsssss (called "packed DMS" by some).
- degrees, minutes and decimals of a minute; i.e. in the representation DDD MM.mmmm.
- radians, i.e. in the format = RR.rrrrrrrr.

Precision of P1/90 format seismic location data

Seismic 2D location data in the UKOOA P1/90 data exchange format coordinates are limited in precision, simply because the P1/90 format itself limits coordinate resolution.

Latitude and longitude in degrees in P1/90 are in a packed sexagesimal DDMMSS.ss format with arc second storage defined using Fortran format F5.2, which means it only allows a resolution of 0.01 arc second. Similarly, P1/90 map grid coordinates (easting and northing) are limited to a resolution of 0.1 metres. P1/90 allows a resolution of 0.1 metre for height / depth data, the same resolution as easting and northing coordinates when given in metres. In all cases the P1/90 coordinate storage is an order of magnitude less precise than that to which modern geoscience software should allow.

To gain increased precision, E&P users often make use of implied decimals, which are not generally recognised by geospatial software. The users sometimes provide workarounds and generate their own P1 Reader software to manage these limitations. When used out of context, these “workarounds” create their own geospatial data problems.

At the time of publication of this document the P1/11 format is being prepared. This will remove this restriction on resolution

Appendix 6 – Essential elements for description of CRSs and transformations

The following is extracted from Annex A of OGP Geomatics Guidance Note number 373-7, part 1, Using the *EPSG Geodetic Parameter Dataset*. In the table below, elements that are essential for the unambiguous description of coordinate reference system or transformation are indicated by a 0.

Element		Geodetic CRS	Projected CRS	Engineering CRS	Vertical CRS	Transformation
MS Access Table Name	**Entity Name**					
Coordinate Reference System	COORD_REF_SYS_CODE	0	0	0	0	
Coordinate Reference System	COORD_REF_SYS_NAME	0	0	0	0	
Coordinate Axis Name	COORD_AXIS_NAME	0 Note 1	0 Note 1	0 Note 1	0	
Coordinate Axis	COORD_AXIS_ORIENTATION	0 Note 1	0 Note 1	0 Note 1	0	
Coordinate Axis	ORDER	0 Note 1	0 Note 1	0 Note 1	0	
Unit of Measure	Axis unit name	0 Note 1	0 Note 1	0 Note 1	0	
Datum	DATUM_NAME	0	0	0	0	
Ellipsoid	ELLIPSOID_NAME	0	0			
Ellipsoid	SEMI_MAJOR_AXIS	0	0			
Unit of Measure	Ellipsoid semi-major axis unit name	0	0			
Ellipsoid	INV_FLATTENING or 1/f (calculated from a and b)	0 Note 2	0 Note 2			
Prime Meridian	PRIME_MERID_NAME	0	0			
Coordinate_Operation	COORD_OP_NAME		0			0
Coordinate_Operation Method	COORD_OP_METHOD_NAME		0			0
Coordinate_Operation Method	REVERSE_OP					0
Coordinate_Operation	UOM_CODE_SOURCE_COORD_DIFF					0
Coordinate_Operation	UOM_CODE_TARGET_COORD_DIFF					0
Coordinate_Operation Parameter	PARAMETER_NAME		0 Note 3			0 Note 4
Coordinate_Operation Parameter Usage	PARAM_SIGN_REVERSAL					0 Note 4
Coordinate_Operation Parameter Value	PARAMETER_VALUE		0 Note 3			0 Notes 4,5
Unit of Measure	Parameter unit name		0 Note 3			0 Notes 4,5
Coordinate_Operation Parameter Value	PARAM_VALUE_FILE_REF					0 Notes 4,5

Notes:
1 - These attributes are required for each axis.
2 - When the dataset provides only ellipsoid parameters a and b, 1/f may be calculated from a/(a-b).
3 - These attributes are required for each projection parameter.
4 - These attributes are required for each transformation parameter.
5 - Either Parameter Value with unit name or Parameter Value File Reference is required.

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